

Big Lake Aquatic Vegetation Management Plan

Noble County, Indiana

2006 - 2010



<http://129.79.145.7/arcims/statewide%5Fmxd/viewer.htm>

Prepared for:

The Big Lake Association

4878 South Pressler Drive
Albion, IN 46701

Prepared By:

Aquatic Weed Control

P. O. Box 325
Syracuse, IN 46567

Executive Summary

The following report outlines a long-term plant management strategy for Big Lake. Aquatic Weed Control was contracted by the Big Lake Association to conduct aquatic vegetation surveys and propose an aquatic vegetation management plan based on the results of these surveys. Funding for this plan was provided by the Big Lake Association and the Indiana Department of Natural Resources (IDNR) through the Lake and River Enhancement (LARE) program.

In 2006, Aquatic Weed Control conducted a Tier II quantitative plant survey and a Tier I qualitative survey to characterize the plant community of Big Lake. An early season survey was conducted by the IDNR on May 30, 2006, and the late season survey was conducted by Aquatic Weed Control on August 30, 2006. The Tier I survey is designed to give an overview of the plant structure in the lake, while the Tier II survey describes individual species distributions and abundances in more detail.

Based on the results of these surveys a management plan was constructed to help reach the three major management goals established by the IDNR for all Indiana public lakes, including those applying for LARE funding. These three goals are listed below.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

The 2006 vegetation surveys of Big Lake found a plant community with fair species diversity (0.74). Twelve plant species were collected in the August 2006 Tier II survey, and 10 of these 12 plant species were native to Indiana waters. Eurasian watermilfoil (*Myriophyllum spicatum*) and curly leaf pondweed (*Potamogeton crispus*) are the two invasive plant species present in Big Lake. Eurasian watermilfoil is of concern in Big Lake as it was widely distributed throughout the lake in 2006. This plant species provides poor fish habitat, crowds out beneficial native plant species, and can impair recreation when present in great abundance.

Given Eurasian watermilfoil abundance in Big Lake, funding may be awarded by the LARE program to chemically treat areas of infestation. Chemical treatment options for selective, root control of Eurasian watermilfoil include the following herbicides: Sonar, Renovate, and 2, 4-D. Sonar treatments provide the most complete control of Eurasian watermilfoil and can also provide multiple years of control. Renovate and 2, 4-D, while very effective, are normally applied to the same areas on a yearly basis to provide control.

Aquatic Weed Control recommends the use of Sonar (active ingredient: fluridone) for Eurasian watermilfoil control in Big Lake. Sonar will provide the most effective control with very low environmental risk and should also be the most cost effective long term management strategy. However, based on meetings with IDNR fisheries and LARE

biologists, Big Lake will not be considered a candidate for a whole lake Sonar treatment in 2007, as the IDNR would like to further evaluate the effects of Sonar treatments in other area lakes before endorsing its use in Big Lake. However, Big Lake may be considered as a candidate for a Sonar treatment in future years, pending the results of current Indiana projects involving the use of Sonar.

The 2007 treatment plan will use a combination of 2, 4-D and Renovate to provide control of Eurasian watermilfoil in Big Lake. Exact treatment areas will depend upon results of a spring 2007 vegetation survey, and up to 40 acres of Big Lake may be treated to reduce the Eurasian watermilfoil population.

2, 4-D will be used in the first and largest basin of Big Lake. Renovate will be used in basins 2 and 3. Using Renovate in basins 2 and 3 will protect native coontail, as 2, 4-D can achieve some control on coontail. Using 2, 4-D in basin #1 will lower costs significantly and any damage to native coontail would take place areas of intense recreational use.

It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will be awarded only for the control of invasive plant species. The goal is not to eliminate vegetation in Big Lake, but to improve the health of the plant community. The major objective will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

Cost estimates for this project are included below. These figures are estimates only and are subject to change pending 2007 herbicide pricing. The current survey and planning cost is \$4,000 but this cost may be reduced, pending 2007 LARE survey and planning requirements.

Project	Total Cost	LARE Share	Association Share
Treat up to 18 acres in Basin #1 with 2, 4-D	\$6,480	\$5,832	\$648
Treat up to 22 acres in Basins #2 and #3 with Renovate	\$10,450	\$9,405	\$1,045
2007 Plant Surveys and Plan update	Up to \$4,000	Up to \$3,600	Up to \$400
Totals	\$20,930	\$18,837	\$2,093

Acknowledgements

Aquatic vegetation surveys conducted on Big Lake were made possible by funding from the Big Lake Association and the Indiana Department of Natural Resources through the Lake and River Enhancement program (LARE). Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for both Tier I and Tier II aquatic vegetation surveys. Gwen White and Angela Sturdevant, aquatic biologists for the LARE program provided valuable consultation regarding the requirements and objectives of this lake management plan. Brad Fink and Jason Doll also provided assistance and training for data analysis computer programs. Aquatic Weed Control would also like to thank the members of the Big Lake Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on October 24, 2006.

Table of Contents

Executive Summary	II
Acknowledgements	IV
Table of Contents	V
List of Figures.....	VII
List of Tables	VIII
1.0 Introduction.....	9
2.0 Watershed and Lake Characteristics.....	9
3.0 Lake Uses	11
5.0 Problem Statement.....	14
6.0 Vegetation Management goals and Objectives	15
8.1 Methods.....	16
8.1.1 Tier I.....	17
8.1.2 Tier II	18
8.1.3 Analytical Methods	21
8.2 Results	22
8.2.1 Tier I Results	22
8.2.2 Tier II Results.....	29
8.3 Macrophyte Inventory Discussion.....	39
9.0 Aquatic Plant Management Alternatives.....	40
9.1 No Action	40
9.2 Institutional-Protection of Beneficial Vegetation.....	40
9.3 Environmental Manipulation	41
9.3.1 Water Level Manipulation	41
9.3.2 Nutrient Reduction	41
9.4 Mechanical Controls.....	42
9.4.1 Mechanical Cutting and Harvesting	42
9.5 Manual Controls	42
9.5.1 Hand Pulling, Cutting, Raking	42
9.5.2 Bottom Barriers	43
9.6 Biological Controls.....	43
9.6.1 Water Milfoil Weevil	43
9.6.2 Grass Carp.....	44
9.7 Chemical Controls	44
9.7.1 Aquatic Herbicides.....	44
10.0 Public Involvement	46
11.0 Public Education	47

Hydrilla	49
12.0 Integrated Treatment Action Strategy.....	50
13.0 Project Budget.....	51
14.0 Monitoring and Plan Update Procedures	51
15.0 References.....	52
16.0 Appendices.....	54
16.1 Calculations	54
16.2 Common Aquatic Plants of Indiana.....	55
16.3 Pesticide Use Restrictions Summary:.....	62
16.4 Public Input Questionnaire Data.....	63
16.5 Resources for Aquatic Management	64
16.6 State Regulations for Aquatic Plant Management	65
16.7 Species Distribution Maps.....	67
16.8 Data Sheets	80
16.9 Permit Application.....	92

List of Figures

Figure 1: Big Lake Watershed Boundaries	10
Figure 2: Big Lake Bathymetric Map	11
Figure 3: Big Lake 2006 Submersed Plant Beds	23
Figure 4: Big Lake 2006 Emergent Plant Beds	26
Figure 5: 2006 Tier II Sample Sites	29
Figure 6: August 2006 Chara Sites	67
Figure 7: August 2006 Coontail Sites	68
Figure 8: August 2006 Curly Leaf Pondweed Sites	69
Figure 9: Spring 2006 Eurasian Watermilfoil Sites	70
Figure 10: August 2006 Eurasian Watermilfoil Sites	71
Figure 11: August 2006 Eelgrass Sites	72
Figure 12: August 2006 Elodea Sites	73
Figure 13: August 2006 Elodea Sites	74
Figure 14: August 2006 Largeleaf Pondweed Sites	75
Figure 15: August 2006 Leafy Pondweed Sites	76
Figure 16: August 2006 Richardson's Pondweed Sites	77
Figure 17: August 2006 Sago Pondweed Sites	78
Figure 18: August 2006 Slender Naiad Sites	79

List of Tables

Table 1: IDNR Fisheries Species List (Pearson, 2000)	12
Table 2: IDNR Fisheries Age Calculations (Pearson, 2000)	13
Table 3: Sample Depth by Trophic State	19
Table 4: Sample Sites by Lake Size and Trophic State	19
Table 5: 2006 Tier I Submersed Plant Beds	24
Table 6: 2006 Tier I Emergent Plant Beds.....	27
Table 7: Spring 2006 Data Analysis: All Sites	30
Table 8: Spring 2006 Data Analysis: 0-5 Foot Depth Contour	30
Table 9: Spring 2006 Data Analysis: 5-10 Foot Depth Contour	31
Table 10: Spring 2006 Data Analysis: 10-15 Foot Depth Contour	31
Table 11: August 2006 Data Analysis: All Sites	32
Table 12: August 2006 Data Analysis: 0-5 Foot Depth Contour.....	32
Table 13: August 2006 Data Analysis: 5-10 Foot Depth Contour.....	33
Table 14: August 2006 Data Analysis: 10-15 Foot Depth Contour.....	33
Table 15: Big Lake 2006 Site Frequencies	34
Table 16: Spring 2006 Mean and Relative Densities.....	35
Table 17: August 2006 Mean and Relative Densities.....	36
Table 18: 2006 Species Dominance.....	37
Table 19: Spring 2006 Relative Frequencies of Occurrence	38
Table 20: August 2006 Relative Frequencies of Occurrence	38
Table 21: Big Lake Public Questionnaire.....	46
Table 22: 2007 Cost Estimates	51
Table 23: Pesticide Use Restrictitons.....	62
Table 24: Public Questionnaire Sample.....	63

1.0 Introduction

Aquatic Weed Control was contracted by the Big Lake Association to develop a long-term aquatic vegetation management plan. Funding for this report was provided by the Big Lake Association and the Department of Natural Resources through the Lake and River Enhancement (LARE) program.

When a person registers a boat within the state of Indiana a lake enhancement fee is included in the cost of registry. Two thirds of the total proceeds collected from this fee are then used to fund projects designed to improve the quality of Indiana lakes. One third of the total proceeds is set aside for invasive plant control, while one third is set aside for sediment removal and construction projects that benefit Indiana lakes.

The aquatic vegetation surveys included in this report, as well as the management plan, are required by the state to receive funding for the treatment of exotic aquatic vegetation. Should a lake be selected for LARE funding, up to 100,000 dollars can be awarded for a whole lake treatment. Following a whole lake treatment up to 20,000 dollars per year can be awarded for up to 3 years for the maintenance of aquatic invasive plant species. If the whole lake is not treated, up to 20,000 dollars can be available annually for up to three years. Requests for funding are reviewed by the LARE office and funds will be distributed at the discretion of the director of the DNR.

This project was initiated to take a more aggressive approach to controlling Eurasian watermilfoil in Big Lake. Eurasian watermilfoil is widely distributed throughout Big Lake. It is most abundant in late spring and early summer. In mid to late summer Eurasian watermilfoil abundance declines as water temperatures and algal blooms increase. The proposed management strategy in this report is aimed at providing effective control for Eurasian watermilfoil while minimizing environmental risks, improving fish habitat, and enhancing recreational opportunities at Big Lake.

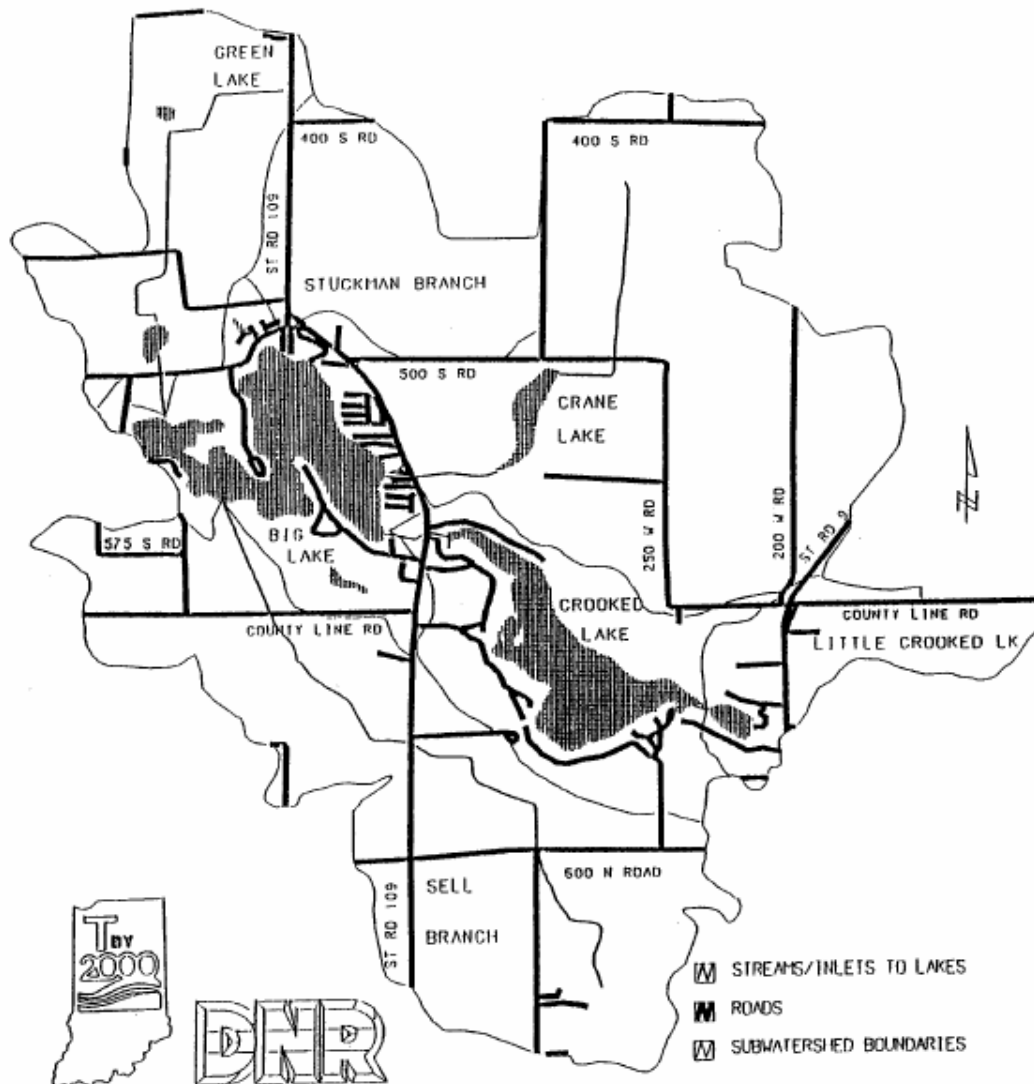
It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will be awarded only for the control of invasive plant species. The goal is not to eliminate vegetation in Big Lake, but to improve the health of the plant community. The goal will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

2.0 Watershed and Lake Characteristics

Big Lake is located in southwest Noble County, 7 miles north of Columbia City on State Road 109. It has 228 surface acres with a maximum depth of 70 feet and an average depth of 24.7 feet (Pearson, 2000). Water volume is estimated at 1.83 billion gallons (IDNR Division of Soil Conservation 1995). Total littoral area is estimated at 40 acres. Big Lake has five inlets, with the two largest being Sell Branch Inlet entering in the southeast and the Crane Lake Inlet entering the lake from the northeast.

The full watershed of Big Lake covers approximately 6,026 acres and includes Crooked Lake, Crane Lake and Green Lake. Figure 1 is adapted from the LARE program's assessment of the Big Lake watershed in 1995. It shows general boundaries of the Big Lake watershed.

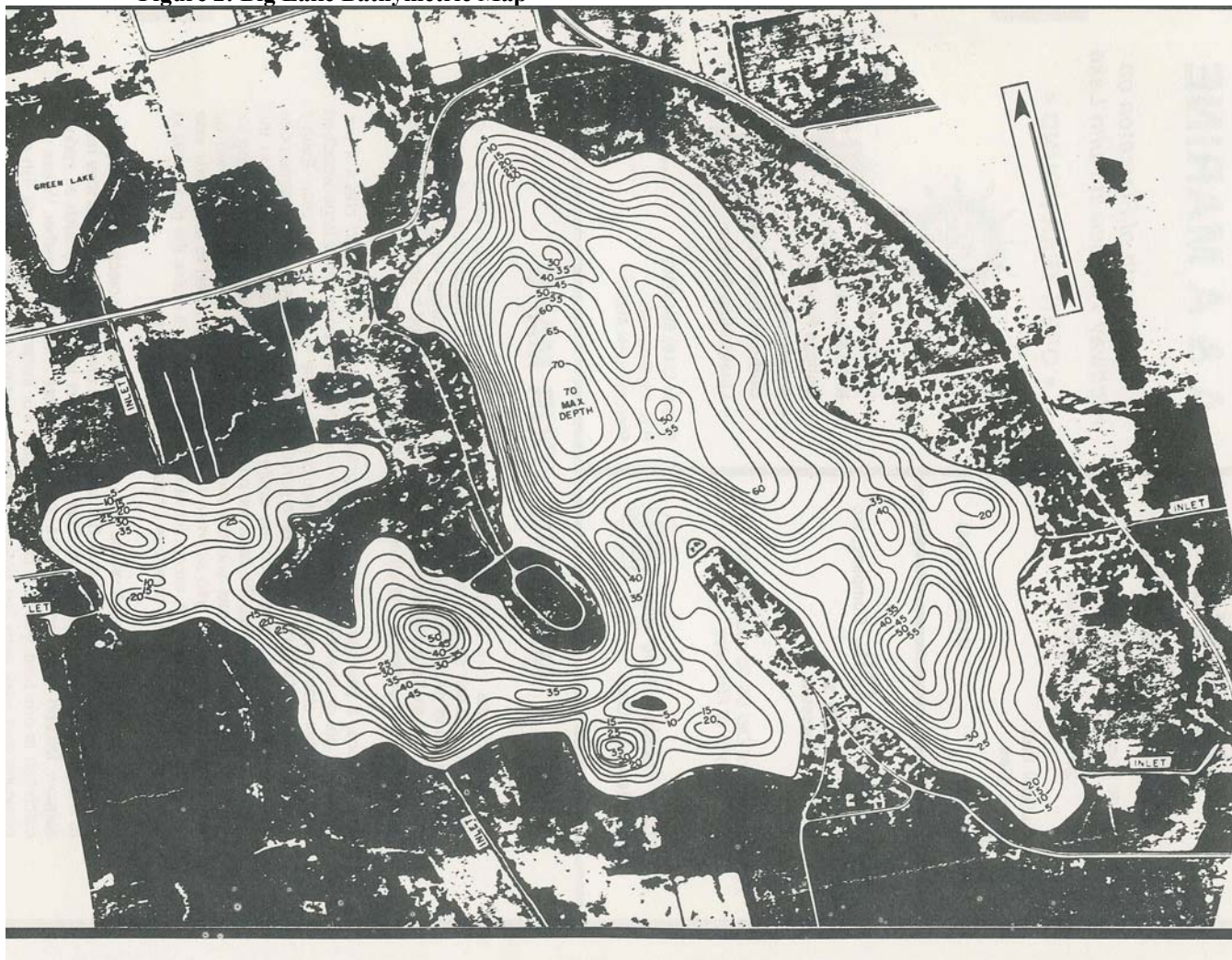
Figure 1: Big Lake Watershed Boundaries



Major land use in the Big Lake watershed is for agricultural purposes, and about 75% of the lake's shoreline is developed, making nutrient loading a concern for Big Lake. Blue-green algal blooms are also common during summer months, decreasing water clarity in Big Lake. Secchi disk readings are historically around 5 feet (Tyllia, 2002) although they can vary depending on algal blooms and precipitation.

Figure 2 is a bathymetric map of Big Lake from Uncle Larry's Lake Maps. Much of the lake contains relatively deep water with the deepest hole being in basin #1. The dropoff is very steep in most of the lake, limiting the amount of shallow water in which aquatic plants can grow. The south shoreline of the second basin and much of the third basin are undeveloped and should be protected to prevent a further decrease in water quality in Big Lake. (Basins are labeled in Figure 3.)

Figure 2: Big Lake Bathymetric Map



3.0 Lake Uses

Big Lake is valuable to both lake residents and the general public as well. A public access site was constructed by the IDNR in 1986. This site is located in the southeast corner of the first basin just off of Lakeshore Drive. This site makes Big Lake accessible to the general public, meaning that any management practices implemented on the lake will benefit a large number of Indiana residents.

Popular activities on the lake include boating, skiing, fishing, and nature observation in the undeveloped portions of the second and third basins.

Big Lake is a popular lake for fishermen. Largemouth bass, bluegills and yellow perch are all very popular sport fish and all are common in Big Lake. More information about the Big Lake fishery is included in section 4.0 in this report. Summer weekends can be very crowded on the lake, with the public access site having limited parking space available. The lake also has a 10 mph speed limit, with high speed boating permitted in the first basin between 1 p.m. and 4 p.m. daily.

4.0 Fisheries

The most recent fisheries survey on Big Lake was conducted by the IDNR on June 5 through June 8 of 2000. Table 1 shows a species list of all fish collected during this survey.

Bluegills were the most commonly collected fish, while largemouth bass accounted for 44% of the catch by weight. Yellow perch were the third most collected species, and many of these fish were of harvestable size. The following information was provided by IDNR District 3 Fisheries Biologist Jed Pearson.

Table 1: IDNR Fisheries Species List (Pearson, 2000)

Relative Abundance, Size and Estimated Weight of Fish Collected at Big Lake

Common Name*	Number	Percent	Minimum Length (in)	Maximum Length (in)	Weight (lb)**	Percent
Bluegill	534	49.1	1.4	10.0	54.56	11.5
Largemouth bass	359	33.0	3.6	17.2	212.05	44.8
Yellow perch	51	4.7	7.1	12.8	28.60	6.0
Spotted gar	32	2.9	12.4	33.7	62.48	13.2
Redear	29	2.7	3.0	10.9	13.94	2.9
Warmouth	15	1.4	3.9	9.4	2.39	0.5
Brook silverside	13	1.2	2.7	4.0	0.06	0.0
White sucker	9	0.8	16.4	20.8	21.33	4.5
Bowfin	9	0.8	20.7	26.7	41.64	8.8
Black crappie	8	0.7	4.0	10.0	1.24	0.3
Pumpkinseed	7	0.6	5.2	7.2	1.37	0.3
Yellow bullhead	4	0.4	8.2	10.5	1.57	0.3
Brown bullhead	4	0.4	13.0	15.0	5.49	1.2
Lake chubsucker	4	0.4	7.5	11.3	1.98	0.4
Spotted sucker	4	0.4	13.3	20.2	10.11	2.1
Golden shiner	3	0.3	7.7	7.9	0.55	0.1
Northern pike	1	0.1	28.5		5.25	1.1
Carp	1	0.1	26.5		8.50	1.8
	1087				473.11	

Growth rates were well above average for yellow perch when compared to other Indiana Lakes, as age 5 were 10.6 inches and age 6 perch were 10.9 inches. Growth rates for bluegills were slightly above average, with age 6 bluegills averaging 8.7 inches in length. Growth rates for largemouth bass were average, with age 5 bass being around 12.7 inches in length. Table 2 summarizes age back-calculations for these 3 species.

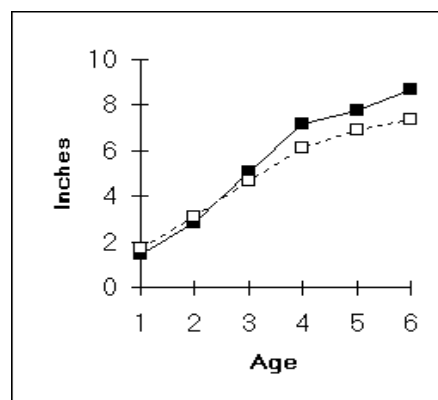
Table 2: IDNR Fisheries Age Calculations (Pearson, 2000)

Bluegill
Intercept: 0.8 inch

BACK-CALCULATED LENGTH (inches) AT EACH AGE

Year	Count	I	II	III	IV	V	VI	Bluegill growth (solid line) compared to other lakes (dotted line).
1999	11	1.6						
	stdev	0.18						
1998	19	1.4	2.7					
	stdev	0.27	0.42					
1997	31	1.4	2.8	5.1				
	stdev	0.20	0.60	1.10				
1996	12	1.4	2.8	5.4	7.5			
	stdev	0.16	0.45	0.55	0.85			
1995	2	1.3	2.5	4.5	7.5	8.3		
	stdev	0.04	0.17	0.62	0.46	0.08		
1994	4	1.5	3.0	4.7	6.8	7.8	8.7	
	stdev	0.32	1.02	1.47	1.18	0.81	0.42	
Mean*		1.5	2.8	5.1	7.1	7.8	8.7	
SD		0.09	0.12	0.32	0.44			
Count		77	66	47	16	4	4	

* Age groups with less than three samples not included in year class averages

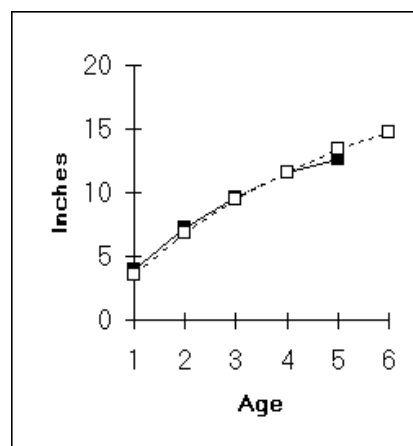


Largemouth bass
Intercept: 0.8 inch

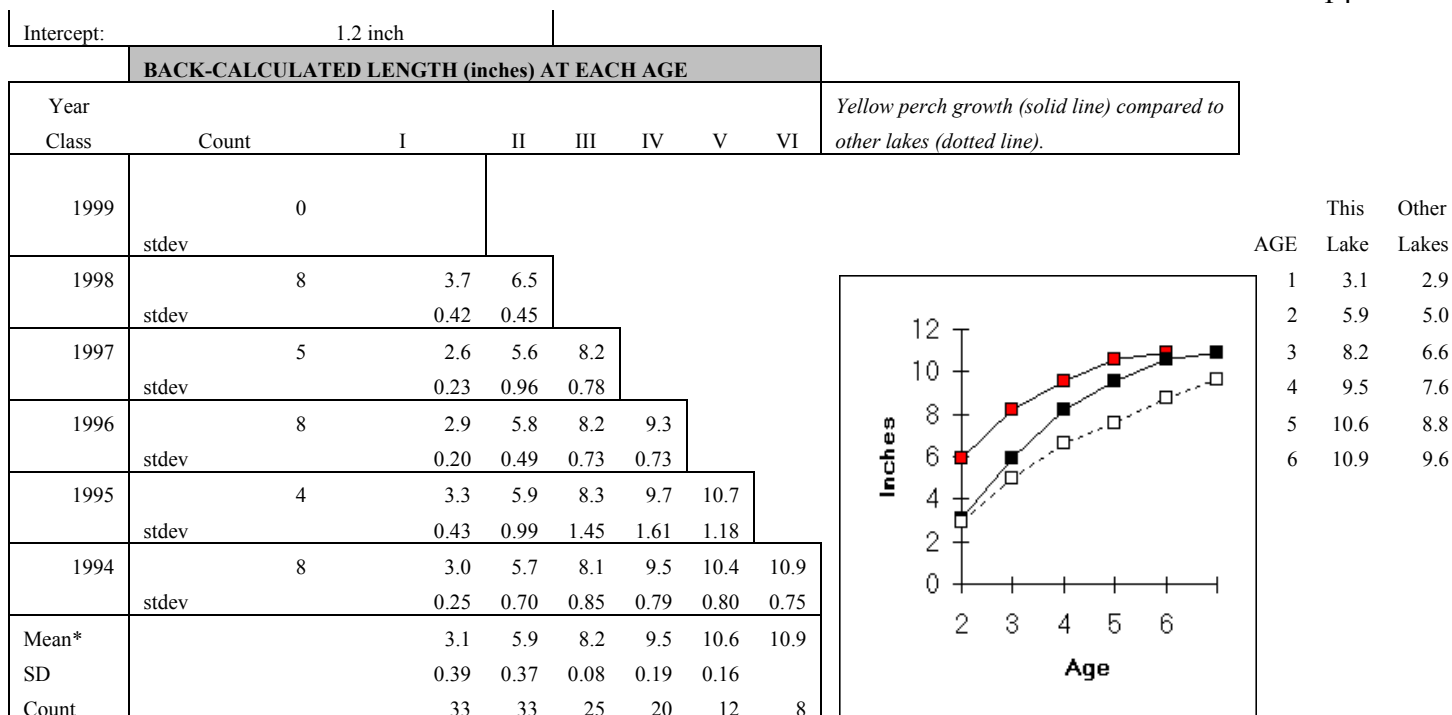
BACK-CALCULATED LENGTH (inches) AT EACH AGE

Year	Count	I	II	III	IV	V	VI	Largemouth bass growth (solid line) compared to other lakes (dotted line).
1999	10	3.7						
	stdev	0.55						
1998	15	4.1	7.0					
	stdev	0.46	0.53					
1997	25	4.1	7.5	9.2				
	stdev	0.65	1.09	0.78				
1996	20	3.8	7.4	10.0	11.4			
	stdev	0.41	0.95	1.07	1.07			
1995	14	3.9	6.9	9.5	11.6	12.7		
	stdev	0.58	0.91	1.28	0.99	0.81		
1994	1	3.3	8.2	11.1	12.9	15.1	16.1	
	stdev							
Mean*		3.9	7.2	9.6	11.5	12.7		
SD		0.19	0.29	0.40	0.14			
Count		84	74	59	34	14		

* Age groups with less than three samples not included in year class averages



Yellow perch



* Age groups with less than three samples not included in year class averages

5.0 Problem Statement

Eurasian watermilfoil is the invasive species of the most concern in Big Lake. In lakes where Eurasian milfoil is left unchecked, well-diversified plant communities can be decimated, although in some lakes native plants compete well with Eurasian watermilfoil. Eurasian watermilfoil has the ability to over winter, giving it a distinct growth advantage over many native plants. The milfoil lies dormant during the winter months instead of dying back completely as do many natives. As spring arrives, the dormant milfoil plants have a head start on many native plants and reach the surface faster, shading out the natives. Eurasian milfoil grows profusely, provides poor fish habitat, inhibits boat navigation, and causes annoyances and even serious recreational hazards to skiers, swimmers, and other members of the public wishing to enjoy the lake.

Big Lake's littoral zone (shallow water area) occupies a relatively small percentage of its total surface acreage (~17%). The large amount of deep water in the lake helps limit milfoil distribution, although it still causes significant recreational impairment in near shore areas around docks, piers and beaches. The near shore areas should be the focus of management activities to improve recreation and reduce the Eurasian watermilfoil population. By selectively treating for Eurasian watermilfoil on a yearly basis, native plants may replace the milfoil in areas that were once heavily infested.

Curly leaf pondweed is another invasive aquatic plant found in moderate abundance in Big Lake. Currently funding is rarely awarded for the treatment of curly leaf pondweed, as LARE funds must be prioritized to meet a growing number of needs. However, the curly leaf pondweed should be monitored to document any population growth in Big Lake.

6.0 Vegetation Management goals and Objectives

The following management goals have been established by the IDNR for all lakes in Indiana, including those applying for LARE funding. Any management practices implemented on Big Lake are to directly facilitate the achievement of these three goals:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Specific Objectives:

Specific objectives are needed to ensure that the fundamental goals of the LARE program are met. The following steps are recommended to help achieve LARE management goals for Big Lake.

1. **Areas infested with Eurasian watermilfoil in basin #1 will be treated with 2, 4-D to reduce the Eurasian watermilfoil population.** Exact treatment areas will depend upon results of a spring 2007 survey.
2. **Areas infested with Eurasian watermilfoil in basins #2 and #3 will be treated with Renovate.** Again, exact treatment areas will depend upon results of a spring 2007 survey. Renovate treatments will protect native coontail in these areas.
3. **Vegetation surveys should be conducted to evaluate the plant community both before and after treatment in 2007.** A Tier II vegetation survey should be conducted after the chemical treatment to evaluate the plant community.

7.0 Past Management Efforts

According to IDNR vegetation control permits, approximately 11.5 acres of Big Lake were treated with contact herbicides in 2006. These treatments were done upon request by private property owners in basins #1 and #2. Before Big Lake's involvement in the LARE program no lake wide vegetation management strategy had been fully developed, and chemical treatments were limited to contact herbicides applied along lake frontages at the request of property owners. The vegetation management strategy in this plan should provide better control of Eurasian watermilfoil on a larger scale and improve recreational access to Big Lake.

8.0 Aquatic Plant Community Characterization

All lake management plans submitted for LARE funding must be accompanied by lake-wide aquatic vegetation surveys. These surveys are used to ensure that the plant community of the entire lake is adequately characterized. They provide information about the overall structure of the plant community, and describe species distribution and abundance in detail.

Two surveys are conducted on each lake in the first year it is involved in the LARE program. One survey is conducted in the spring and another is conducted later in the summer. This two-survey process is essential in providing an accurate representation of all plant species in a lake. Some species such as eel grass (*Vallisneria americana*) are not prevalent until summer and may be under-represented if only one survey was conducted in the spring. Other species such as curly-leaf pondweed (*Potamogeton crispus*) are prevalent in the spring and die off in the summer. This species would be under-represented if only one survey was conducted in the summer. Because of the diverse life cycles of different plants, multiple surveys increase the chance of accurately representing all of the species in a lake

Tier I and Tier II survey protocols have been established by the IDNR to ensure that each lake is surveyed in the same manner. These surveys reduce subjectivity and provide a consistent basis for the evaluation of a lake's plant community from year to year, as well as a basis for comparing the plant communities of different lakes. They provide quantifiable results that are vital for monitoring the success of management programs. In short, these vegetation surveys are the foundation for describing an aquatic plant community and proposing an effective management strategy.

8.1 Methods

This section provides an overview of the purpose and procedures behind the Tier I and Tier II vegetation surveys. The common goal of these surveys is to accurately describe the aquatic plant community of any particular lake. Standard procedures are established to ensure that:

1. The same survey procedures are used for each lake applying for funding.
2. Subjectivity is kept to a minimum to maintain scientific integrity.
3. The sample size for each survey adequately describes the plant community.
4. All data from each lake is recorded and analyzed in the same format.

In short, procedural and analytical consistency makes data from different surveys suitable for comparison and evaluation, while increasing its reliability and overall utility for evaluating the health of a plant community.

The Tier I survey involves finding and identifying the major plant beds in the lake. In lakes with high water clarity, this can be accomplished visually. In lakes with low water clarity, a rake may be lowered into the water to collect plants and identify areas of abundant plant growth. The composition of each major plant bed is then recorded.

The Tier II survey involves using a specially designed rake to collect plants from numerous sites throughout the entire lake. At each site, each species found is recorded, and given an abundance rating based on the amount collected.

These protocols are currently being used by IDNR fisheries biologists to describe the plant communities of Indiana lakes. They are accepted as practical ways describe a plant community in detail and provide quantifiable evidence as to the overall health of an ecosystem. For these reasons, the following surveys are being used to describe plant communities in all lakes applying for LARE funding.

8.1.1 Tier I

The Tier I reconnaissance survey is designed to identify the major plant beds present in a body of water. This is a qualitative survey designed to give an overview of the aquatic vegetation present in a lake. It identifies and documents problem areas that can be targeted when management practices are implemented. Major submersed plant beds are found visually from a boat. Each bed is given a reference number that is recorded on Tier I data sheets. The general location of these beds are recorded on a bathymetric map of the lake, and more precise locations are recorded on Tier I data sheets with the help of a WAAS enabled GPS unit.

When a major plant bed is identified, each species of plant found in that bed is recorded. Canopy ratings are given to each plant bed based on the types of plants present in that bed. The four major types of plants to be identified in this study are as follows: submersed plants, emergent plants, non-rooted floating plants and rooted floating plants. The following scale is used to describe these four types of plants based on the percentage of the plant bed canopy they occupy:

Canopy Rating

1 = < 2% of canopy

2 = 2-20%

3 = 21-60%

4 = >60% of canopy

In addition to the canopy rating, another abundance rating is given to each individual species found in a particular plant bed. This abundance rating is based on the percentage of the entire bed area that species appears to occupy. The scale for this abundance rating is the same as the canopy rating scale. The difference is that this scale identifies the abundance of *individual species* in the bed:

Species Abundance Rating

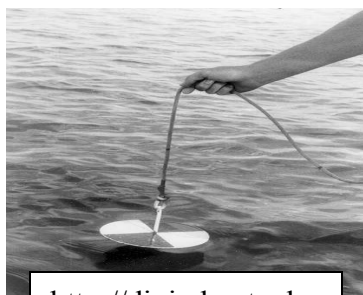
1 = < 2% of the bed

2 = 2-20%

3 = 21-60%

4 = >60% of the bed

Secchi disk readings are taken prior to the vegetation surveys. Secchi are plate-like objects



<http://dipin.kent.edu>

used to measure water clarity. The disk is lowered into the water until it disappears. Once it has disappeared, it is then raised slightly until it is just barely visible. At this point, marked points on the secchi rope are used to determine the maximum depth at which the disk can be seen. In lakes with clear water, the Tier I survey is primarily a visual survey, in lakes with low water clarity, rake throws and the use of electronics help to locate and describe plant beds. The Tier I survey is a valuable tool that helps to provide an overall picture of an aquatic plant community when coupled with the Tier II

quantitative survey.

8.1.2 Tier II

The purpose of Tier II surveys is to document the distribution and abundance of submersed and floating-leaved aquatic vegetation throughout a lake (IDNR, 2004). A specific number of sample sites are selected based on the amount of surface acreage the lake possessed. Once sample sites are determined, sampling is accomplished using an aquatic vegetation sampling rake constructed according to the guidelines of the 2006 Tier II random sampling procedure manual.

Aquatic vegetation collected at each sample site is sorted according to species, and given a value to represent its abundance at that site. These values are recorded on data sheets distributed by the IDNR. These records are used for data analysis that served to characterize the aquatic vegetation community of Big Lake.

Random Sampling:

The Tier II survey protocol was changed by the IDNR in 2006. New LARE Tier II protocol requires that sample sites be stratified by depth contour. Prior to 2006 sites were to be spaced evenly through the littoral zone.

Before 2006, the number of sample sites required each lake were determined strictly by lake size. In the 2006 protocol, the number of sample sites needed is based on both lake size and trophic state. Trophic state describes the productivity of a lake and is correlated with plant growth, secchi disk, and nutrient availability. There are 4 different trophic states listed by the IDNR: Oligotrophic, Mesotrophic, Eutrophic, and Hypereutrophic. Oligotrophic Lakes usually have clear water and few nutrients, while Hypereutrophic lakes usually have deeply stained water and are nutrient rich. Table 3 is taken from the IDNR 2006 Tier II protocol and shows the maximum depth that must be sampled for a lake in each trophic state. In

oligotrophic lakes, where water is clear, plants may be able to grow in up to 25 feet of water because sunlight may still reach the lake bottom in deep water. In hypereutrophic lakes where water is turbid, lack of sunlight will prevent plants from growing in deep water, so the maximum sampling depth is only 10 feet.

Table 3: Sample Depth by Trophic State

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 4 is used to calculate the number of sample sites need in each depth contour by using lake size and trophic status. The new protocol attempts to more accurately describe the entire littoral zone of a lake and provide more detailed data analysis by separating the littoral zone into 5 foot depth segments.

Table 4: Sample Sites by Lake Size and Trophic State

Tier II Sampling 3

Table 3. Sample size requirements as determined by lake size, trophic state, and apportioned by depth class.

Lake Acres	Total # of Sites	Hypereutrophic			Eutrophic			Mesotrophic				Oligotrophic				
		0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	20-25 foot contour
<10	20	10	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	19	18	10
≥800	100	90	10	57	33	10	33	31	26	10	25	23	22	22	20	10

Based on Big Lake's 228 surface acres and its classification as eutrophic, 60 sample sites were needed to describe this plant community. Aerial photographs and bathymetric maps were used to evenly space the sample sites throughout the lake. The littoral zone of the lake was divided into four quadrants of equal length. During the vegetation collection process, an effort was made to collect plants from an equal number of sites in each quadrant to ensure that the entire littoral zone was surveyed adequately and that random sample sites distributed evenly throughout the lake. Sample points were also distributed by 5 foot depth contour. At Big Lake, Aquatic Weed Control used the same sample locations as the spring 2006 IDNR survey to provide consistency in the data.

Aquatic Vegetation Sampling Rake:

A double-headed garden rake was used to sample aquatic vegetation. This rake design is approved and used by IDNR fisheries biologists in vegetation surveys on many Indiana lakes. It consists of two garden rake heads welded together back to back so that rake teeth are

protruding from two sides. The dimensions of the rake are to be 13.5 inches wide with 2.25-inch long teeth spaced 0.75 inches apart (IDNR, 2004).

Each tooth on the rake head is divided into five equal sections and marked accordingly. These marks on the rake teeth are used to estimate the abundance of plant species when they are collected.

A nylon rope is then attached to the rake head. A black permanent marker is used to mark the rope in foot long increments. A red mark is placed every five feet along the rope. This rope is used to measure the depth at each sample site when the rake is lowered to the lake bottom.

GPS and Mapping:

A WAAS enabled GPS unit was used to obtain and record the coordinates of each sample site on the lake. A WAAS enabled GPS unit is accurate to within 3 meters and was recommended to obtain maximum accuracy for mapping sample sites. All GPS coordinates were then used to produce computer generated maps of the lake with each sample site labeled on the map.

Sampling Procedure

A two-person crew accomplished Tier II aquatic vegetation sampling by boat. A crew leader was responsible for driving the boat to each sample site and recording vegetation data on record sheets issued by the IDNR. An assistant was responsible for collecting the aquatic plants using the double-headed rake.

When a sample site was reached, its GPS coordinates were obtained and recorded. The boat was then brought to a complete stop and the double-headed rake was lowered to the bottom of the lake. The boat was held stationary while the water depth at the sample site was obtained by using the marked rope attached to the rake. When water depth had been recorded, the crew leader slowly backed the boat away from the rake as the assistant simultaneously let out another ten feet of rope. During this process the rake did not move from the lake bottom.

The rake was pulled from the water after the boat had reached the end of the ten extra feet of rope let out after the depth was recorded. This ensured that the rake was pulled horizontally through the water, giving it a greater chance of collecting weeds than if the rake had been lowered to the bottom and raised vertically. The vegetation caught on the teeth of the rake was then gathered into the boat.

Determining Vegetation Abundance

At each sample site, every plant species collected on the rake was scored according to its abundance. This was accomplished by removing all plants from the rake and sorting them by species. Once all plants had been sorted, they were placed back onto the rake and evenly distributed across the marks on the rake teeth. If a species filled the rake to the first mark on the teeth, that species was given a score of 1 on the abundance data sheet. If it filled the rake teeth to the second or third, or fourth mark, it was given a score of 3, and if plants completely

filled the rake, they were given a score of 5. In many instances it was not necessary to place each species back onto the rake. Many species would fill the rake completely (an abundance of 5) and some species would only have one plant on the rake (an abundance of 1). In addition to abundance scores for individual species, each rake toss was given an overall abundance score, describing how much total vegetation was collected on the rake.

8.1.3 Analytical Methods

One of the methods used to analyze the Tier II data was an IDNR Vegetation Database. Survey data was imported from Microsoft Excel and used to calculate plant community metrics that describe the plant community of a lake. This program and these metrics are used by biologists throughout the state and provide consistency in data analysis procedures. This consistency makes Tier II data more useful for comparisons between lakes and from year to year.

Delorme X-Map 4.5 was used to map major plant beds and individual species distributions. To map individual species, GPS coordinates representing each sample site where the species was collected were imported into the program and displayed on a computer generated map of the lake. For major submersed plant beds and emergent plant beds, a bathymetric map of the lake was imported into the program and geo-referenced to ensure greater accuracy for the locations of plant beds. A combination of GPS coordinates, landmarks, field notes, and the bathymetric map helped to estimate the exact locations of each plant bed. Estimates of plant bed sizes were calculated using X-Map after each bed was drawn on the bathymetric map.

8.2 Results

8.2.1 Tier I Results

The submersed plant community of Big Lake covers roughly 40 acres, or 17.5% of the lake's total surface area. Dominant plants in the spring survey, conducted by the IDNR were coontail, Eurasian watermilfoil and curly leaf pondweed. Plant growth is very limited in depths of more than 10 feet, due to water clarity, morphology, and possibly other factors. More dense plant beds are found in 1-8 feet of water and account for most of the diversity in Big Lake. The deeper edges of these plant beds contain more coontail and Eurasian watermilfoil, while the shallower areas tend to be dominated by eel grass late in the growing season. Maximum depth of these plant beds is approximately 12 feet.

During the 2006 Tier I survey, 6 major plant beds were identified. The composition of these plant beds did show some significant changes from spring to August based on Tier II results acquired from the IDNR. The two most notable changes were the decreases in abundance for curly leaf pondweed and Eurasian milfoil and the increase in abundance for eelgrass as the growing season progressed.

Problem Plant Areas:

The largest threat to the plant community in Big Lake is the presence of Eurasian watermilfoil, although curly leaf pondweed, another invasive species is found in moderate abundance as well. Eurasian watermilfoil was found in every plant bed except for bed #5 in at least one of the 2006 vegetation surveys. It was the second most common plant (behind coontail) in the spring survey. It was not as prevalent in the August 2006 survey, which is likely due to natural die off as water temperatures rise and algal blooms increase throughout the summer. Eurasian watermilfoil was most abundant in the third basin at the west end of the lake.

Beneficial Plant Areas:

Plant beds #1 and #4 were the most diverse plant beds in Big Lake. Plant bed #1 covers the majority of the first and largest basin of the lake, while plant bed #4 consists of the largely undeveloped bay at the west end of the lake. Plant bed # 1 contained 9 plant species while plant bed #4 contained 8 species. Unfortunately, the second most diverse plant bed in the lake (#4) is also one of the most heavily infest with Eurasian watermilfoil in spring (See Figure 9). The large wetland areas in the second and third basins are also very beneficial plant areas. The shoreline of these areas, as well as surrounding land contains at least 16 acres of wetland that provide filtration, shoreline stability, and wildlife habitat for Big Lake. This area is labeled as Emergent Bed #3 on the Tier I emergent map.

Figure 3 shows the locations and acreages for the major plant beds in Big Lake.

Figure 3: Big Lake 2006 Submersed Plant Beds

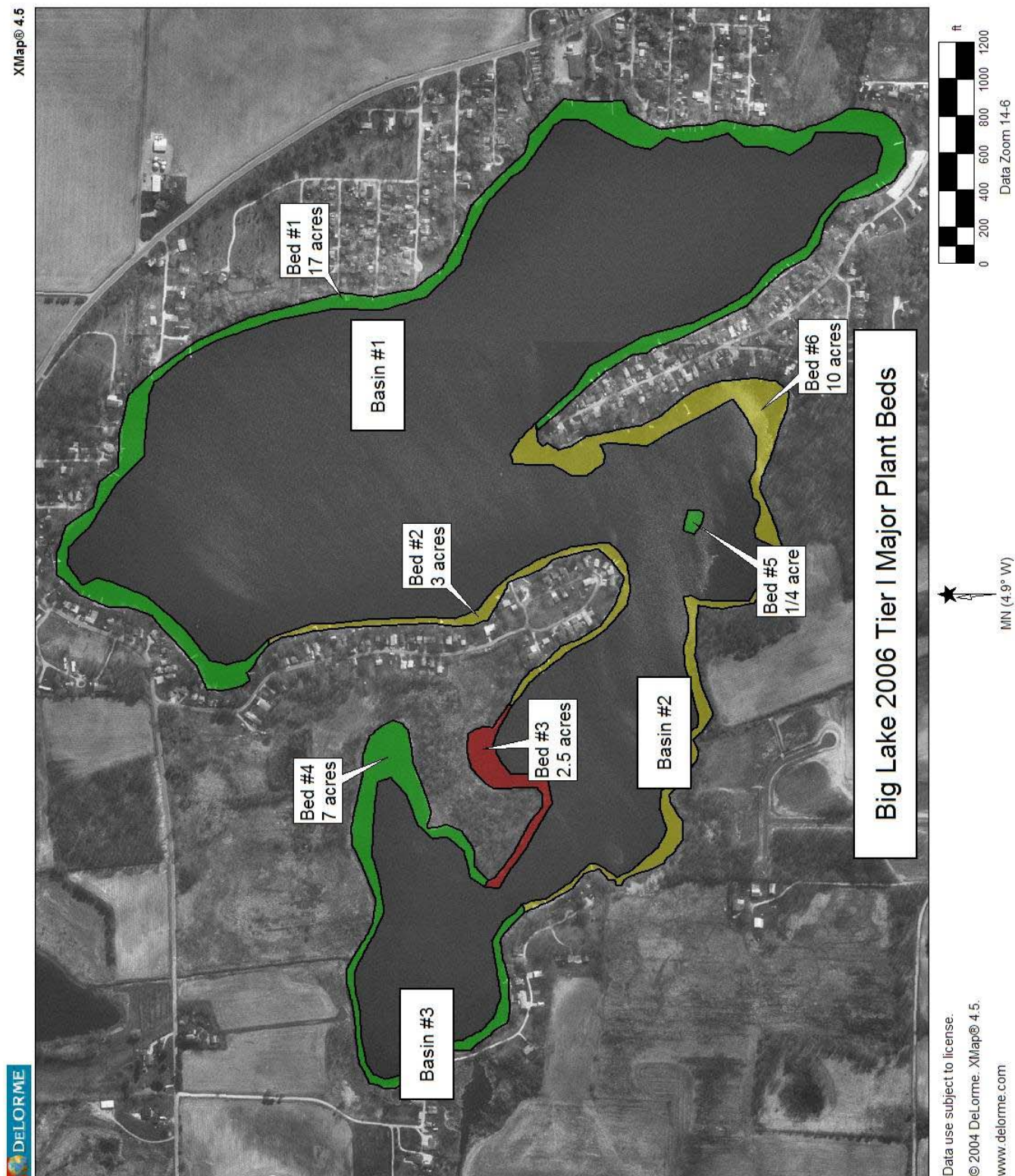


Table 5 shows all of the plant species found in the Tier I survey and their abundance rating for each plant bed. Blanks indicated that the plant was not present in a particular bed.

Table 5: 2006 Tier I Submersed Plant Beds

Big Lake 2006 Tier I Submersed Plants

August 30, 2006

Species Abundance by Plant Bed #

	#1	#2	#3	#4	#5	#6
<u>Plant Species</u>						
Chara	1			2		
Coontail	3	3	3	3	4	3
American Elodea	1					
Illinois Pondweed				2		
Eurasian Milfoil	1		2	1		1
Slender Naiad	2	1		1		
Eelgrass	3	3		2		3
Sago Pondweed	1			1		1
Leafy Pondweed	1					
Richardson's Pondweed				1		
Largeleaf Pondweed						1
Curly-Leaf Pondweed	1	1				
Total # of Species	9	4	2	8	1	5
Size (Acres)	17	3	2.5	7	0.25	10

Plant Bed #1

Size: 17 acres

Substrate: Silt/Sand

Number of Species: 9

Description: This large plant bed was also the most diverse bed in the August survey, containing 9 plant species. It was dominated by eelgrass and coontail (~60%) while Eurasian milfoil was present but in low abundance. Six other native species were also present in low abundance.

Plant Bed #2

Size: 3 acres

Substrate: Silt/Sand

Number of Species: 4

Description: This 3 acre plant bed consisted of 4 plant species. Coontail and eelgrass were again the dominant species in the plant bed (~60%) while slender naiad and curly leaf pondweed were also present in low abundance.

Plant Bed #3

Size: 2.5 acres

Substrate: Silt/Sand

Number of Species: 2

Description: This plant bed is located on the north side of the second basin and consists mainly of coontail and Eurasian watermilfoil. Coontail was dominant in this bed, although Eurasian watermilfoil was scattered throughout the bed.

Plant Bed #4

Size: 7 acres

Substrate: Silt/Sand

Number of Species: 8

Description: This plant bed, located at the west end of the lake was also relatively diverse containing 8 species. Coontail was the most abundant plant in this bed (21-60%) while chara, Illinois pondweed, and eelgrass were all fairly common as well (2-20%). Eurasian watermilfoil, slender naiad, and Richardson's pondweed were all present in much lower abundance (<2%).

Plant Bed #5

Size: ¼ acre

Substrate: Sand/Silt

Number of Species: 1

Description: This plant bed sits on a mid-rise in the second basin. Much of this submersed plant bed is hidden by white lilies, although rake throws revealed that coontail was found growing under the lilies. Coontail was the only submersed plant found in this bed.

Plant Bed #6

Size: 10 acres

Substrate: Sand/Silt

Number of Species: 5

Description: This 10 acre plant bed covers much of the south shoreline of the second basin. It covers both a large area of undeveloped shoreline as well as some developed areas closer to the first basin. No major differences in submersed plant community structure were seen between the developed and undeveloped shoreline. Coontail and eelgrass were dominant again in plant bed # 6. Largeleaf pondweed was present (<2%) as were sago pondweed and Eurasian watermilfoil.

Emergent Plants

Big Lake's emergent plant community covers roughly 17.5 acres. The majority of this acreage is located along the shoreline of the second and third basins of the lake (emergent bed #3, figure 4). Nine wetland plant species were found in six major wetland areas. Cattails, spatterdock, and white lilies were the most commonly occurring species in these wetland areas.

Figure 4: Big Lake 2006 Emergent Plant Beds

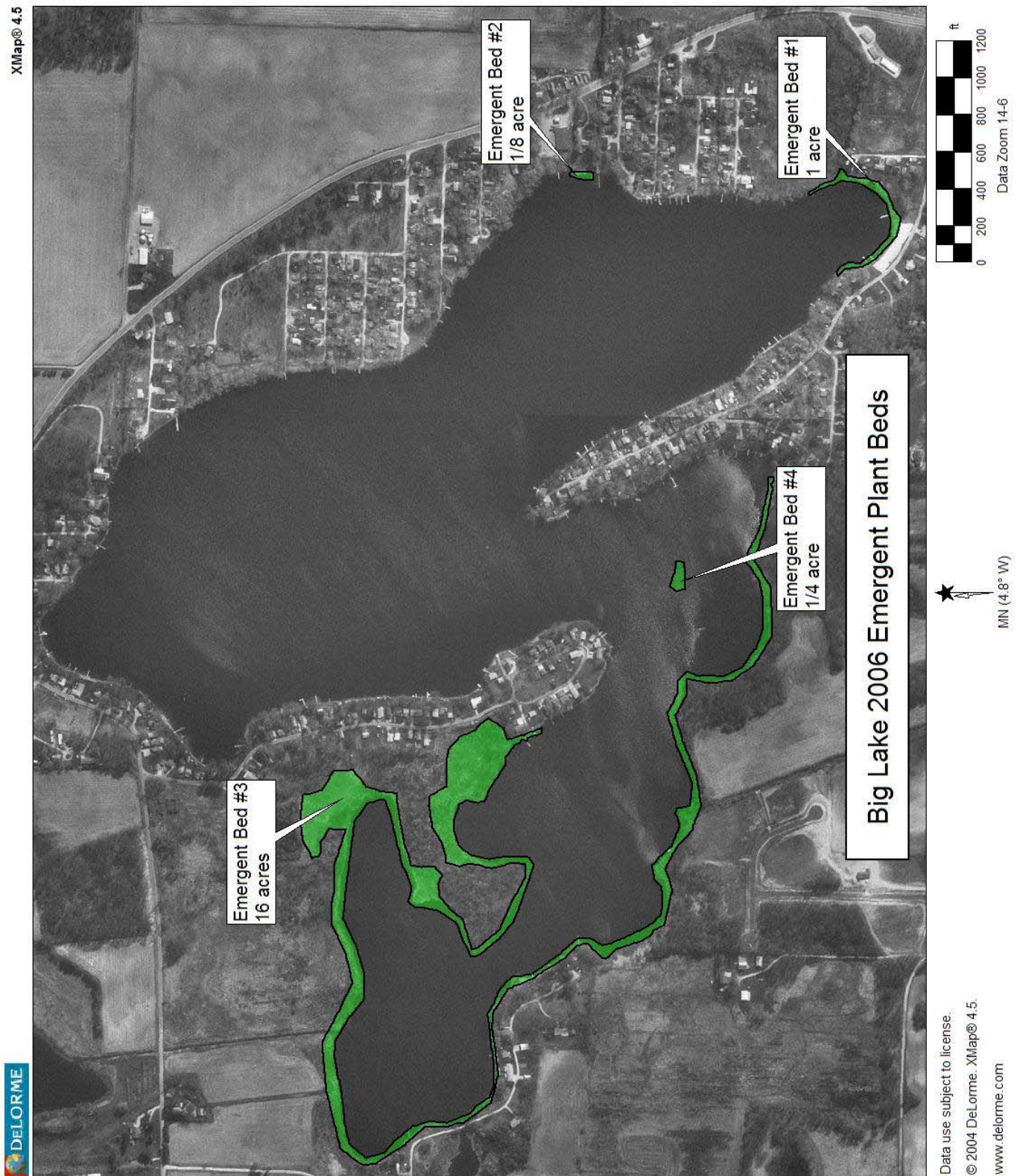


Table 6 describes the plant composition of the major wetland areas of Big Lake. Plant bed numbers in this table correspond to the numbers in figure 4.

Table 6: 2006 Tier I Emergent Plant Beds
Big Lake Tier I Emergent
Plants

Species Abundance By Plant Bed #

	#1	#2	#3	#4
Plant Species				
Spatterdock	3		3	
White Lilly			2	4
Cattails	1	4	3	
Soft Stem Bulrush	1			
Arrowhead	1			
Pickeral Weed	1			
Duckweed	1		1	
Swamp Loosestrife			1	
Purple Loosestrife			1	
Total # of Species	6	1	6	1
<i>Size (Acres)</i>	<i>1</i>	<i>1/8</i>	<i>16</i>	<i>1/4</i>

Emergent Bed #1

Size: 1 acre

Substrate: Silt/Sand

Number of Species: 6

Description: This 1 acre wetland area surrounds the public access site at the south end of the first basin. It contained six plant species. Spatterdock was by far the most dominant plant in this area, while 5 other wetland species were present in low abundance.

Emergent Bed #2

Size: 1/8 acre

Substrate: Silt/Sand

Number of Species: 1

Description: This small plant bed is located on the eastern shoreline of the first basin and is composed of cattails only. The cattails are confined to a small area, mostly on shore, and do not extend out into open water.

Emergent Bed #3

Size: 16 acres

Substrate: Silt/Sand

Number of Species: 6

Description: Emergent bed #3 is by far the largest wetland area in the lake at 16 acres. It starts on the north shore of the second basin and rings the third basin before running along the south shore of the second basin. It is largely unbroken throughout, although there is some limited development in the third basin. Six plant species were found in the bed. Spatterdock

cattails and white lilies were all moderately abundant, while swamp loosestrife, the invasive purple loosestrife, and duckweed were found in lower abundance.

Emergent Bed #4

Size: 1/4 acre

Substrate: Silt/Sand

Number of Species: 1

Description: This very small wetland area is located on the small rise in the middle of the second basin. The only emergent species found in this bed was white lily. Its size is limited by steep drop-offs on all sides of the plant bed, as it is surrounded by deep water.

8.2.2 Tier II Results

Secchi depth was estimated at 3.5 feet in the spring and 2.5 feet in the August survey. Microscopic algae blooms may have contributed to this decrease in water clarity. The spring survey was conducted on May 30, 2006 by the IDNR (Pearson and Caswell, 2006). Sixty rake samples were distributed throughout the lake. A total of 10 species of submersed aquatic plants were collected during the spring 2006 Tier II survey. Of these 10 species, two of them (Eurasian milfoil and curly-leaf pondweed) were exotic. The following map shows the locations of all sample sites during the 2006 Tier II surveys. The same sample locations were used in spring and August to provide consistency in results.

Figure 5: 2006 Tier II Sample Sites



The late season survey was conducted on August 30, 2006 by Aquatic Weed Control. GPS waypoints were used to return to the same sampling locations used in May by the IDNR. In this Tier II survey, 12 species of submersed aquatic plants were collected. Eurasian milfoil and curly-leaf pondweed were both collected again, although both were collected less

frequently. This decline in site frequency may be expected due to the life cycles and water temperature requirements of these two plants.

Tables 7-14 are data summaries for the 2006 aquatic vegetation surveys on Big Lake. These surveys help to describe the plant community, and will help identify any changes that take place in the years to come. Tables 7 and 11 analyze every sample site, while the others describe the plants in each depth contour of the lake (0-5 feet, 5-10 feet, etc).

Table 7: Spring 2006 Data Analysis: All Sites

(Pearson and Caswell,
2006)

Occurrence and Abundance of Submersed Aquatic Plants

Date:	5/30/06	Littoral sites with plants:	52	Species diversity:	0.74
Littoral depth (ft):	15.0	Number of species:	10	Native diversity:	0.52
Littoral sites:	60	Maximum species/site:	5	Rake diversity:	0.65
Total sites:	60	Mean number species/site:	2.05	Native rake diversity:	0.33
Secchi:	3.5	Mean native species/site:	1.13	*Mean rake score:	2.93

Common Name	Site frequency	Rel. Freq	Relative density	Mean density	Dominance
Coontail	76.7	37.4	2.23	2.91	44.7
Eurasian Watermilfoil	65.0	31.7	1.35	2.08	27.0
Curly-leaf Pondweed	26.7	13.0	0.40	1.50	8.0
Leafy Pondweed	13.3	6.5	0.17	1.25	3.3
Eel Grass	5.0	2.4	0.05	1.00	1.0
Naiad sp	5.0	2.4	0.05	1.00	1.0
Elodea sp	5.0	2.4	0.12	2.33	2.3
Chara	3.3	1.6	0.07	2.00	1.3
Waterstargrass	3.3	1.6	0.03	1.00	0.7
Large-leaf Pondweed	1.7	0.8	0.02	1.00	0.3

Table 8: Spring 2006 Data Analysis: 0-5 Foot Depth Contour

(Pearson and Caswell,
2006)

Occurrence and Abundance of Submersed Aquatic Plants

Date:	5/30/06	Littoral sites with plants:	30	Species diversity:	0.77
Littoral depth (ft):	5.0	Number of species:	10	Native diversity:	0.60
Littoral sites:	30	Maximum species/site:	5	Rake diversity:	0.68
Total sites:	30	Mean number species/site:	2.67	Native rake diversity:	0.38
Secchi:	3.5	Mean native species/site:	1.43	*Mean rake score:	3.87

Common Name	Site frequency	Relative density	Mean density	Dominance
Coontail	86.7	2.93	3.38	58.7
Eurasian Watermilfoil	76.7	1.50	1.96	30.0
Curly-leaf Pondweed	46.7	0.73	1.57	14.7
Leafy Pondweed	20.0	0.27	1.33	5.3
Chara	6.7	0.13	2.00	2.7
Eel Grass	6.7	0.07	1.00	1.3
Waterstargrass	6.7	0.07	1.00	1.3
Naiad sp	6.7	0.07	1.00	1.3
Elodea sp	6.7	0.20	3.00	4.0
Large-leaf Pondweed	3.3	0.03	1.00	0.7

Table 9: Spring 2006 Data Analysis: 5-10 Foot Depth Contour(Pearson and Caswell,
2006)**Occurrence and Abundance of Submersed Aquatic Plants**

Date:	5/30/06	Littoral sites with plants:	20	Species diversity:	0.64
Littoral depth (ft):	10.0	Number of species:	7	Native diversity:	0.36
Littoral sites:	20	Maximum species/site:	5	Rake diversity:	0.57
		Mean number		Native rake	
Total sites:	20	species/site:	2.05	diversity:	0.19
Secchi:	3.5	Mean native species/site:	1.20	*Mean rake score:	2.90

Common Name	Site frequency	Relative density	Mean density	Dominance
Coontail	95.0	2.25	2.37	45.0
Eurasian Watermilfoil	75.0	1.75	2.33	35.0
Curly-leaf Pondweed	10.0	0.10	1.00	2.0
Leafy Pondweed	10.0	0.10	1.00	2.0
Eel Grass	5.0	0.05	1.00	1.0
Naiad sp	5.0	0.05	1.00	1.0
Elodea sp	5.0	0.05	1.00	1.0

Table 10: Spring 2006 Data Analysis: 10-15 Foot Depth Contour(Pearson and Caswell,
2006)**Occurrence and Abundance of Submersed Aquatic Plants**

Date:	5/30/06	Littoral sites with plants:	2	Species diversity:	0.50
Littoral depth (ft):	15.0	Number of species:	2	Native diversity:	0.00
Littoral sites:	10	Maximum species/site:	1	Rake diversity:	0.50
				Native rake	
Total sites:	10	Mean number species/site:	0.20	diversity:	0.00
Secchi:	3.5	Mean native species/site:	0.10	*Mean rake score:	0.20

Common Name	Site frequency	Relative density	Mean density	Dominance
Coontail	10.0	0.10	1.00	2.0
Eurasian Watermilfoil	10.0	0.10	1.00	2.0

August Data Analysis

The most significant changes in the August survey were seen in eelgrass, Eurasian watermilfoil and curly leaf pondweed populations. There was a large increase in eelgrass abundance, which is common as the growing season progresses. Eurasian watermilfoil and curly leaf pondweed populations showed decline, which is consistent with their life cycles in relation to rising water temperatures throughout the summer.

Table 11: August 2006 Data Analysis: All Sites

Occurrence and Abundance of Submersed Aquatic Plants					
Date:	8/30/06	Littoral sites with plants:	44	Species diversity:	0.76
Littoral depth (ft):	15.0	Number of species:	12	Native diversity:	0.71
Littoral sites:	60	Maximum species/site:	6	Rake diversity:	0.69
Total sites:	60	Mean number species/site:	1.55	Native rake diversity:	0.65
Secchi:	2.5	Mean native species/site:	1.40	*Mean rake score:	2.60
Common Name	Site frequency	Rel. Freq.	Relative density	Mean density	Dominance
Coontail	60.0	38.7	1.53	2.56	30.7
Eel Grass	40.0	25.8	1.03	2.58	20.7
Slender Naiad	18.3	11.8	0.22	1.18	4.3
Eurasian Watermilfoil	11.7	7.5	0.15	1.29	3.0
Chara	5.0	3.2	0.15	3.00	3.0
Illinois Pondweed	5.0	3.2	0.05	1.00	1.0
Sago Pondweed	5.0	3.2	0.08	1.67	1.7
Curly-leaf Pondweed	3.3	2.2	0.03	1.00	0.7
Richardson's Pondweed	1.7	1.1	0.02	1.00	0.3
Large-leaf Pondweed	1.7	1.1	0.02	1.00	0.3
Leafy Pondweed	1.7	1.1	0.02	1.00	0.3
Elodea sp	1.7	1.1	0.05	3.00	1.0

Table 12: August 2006 Data Analysis: 0-5 Foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants					
Date:	8/30/06	Littoral sites with plants:	30	Species diversity:	0.77
Littoral depth (ft):	5.0	Number of species:	11	Native diversity:	0.72
Littoral sites:	30	Maximum species/site:	6	Rake diversity:	0.70
Total sites:	30	Mean number species/site:	2.37	Native rake diversity:	0.67
Secchi:	2.5	Mean native species/site:	2.10	*Mean rake score:	3.60
Common Name	Site frequency	Relative density	Mean density	Dominance	
Coontail	86.7	2.20	2.54	44.0	
Eel Grass	60.0	1.40	2.33	28.0	
Slender Naiad	30.0	0.37	1.22	7.3	
Eurasian Watermilfoil	20.0	0.20	1.00	4.0	
Chara	10.0	0.30	3.00	6.0	
Illinois Pondweed	10.0	0.10	1.00	2.0	
Curly-leaf Pondweed	6.7	0.07	1.00	1.3	
Richardson's Pondweed	3.3	0.03	1.00	0.7	
Leafy Pondweed	3.3	0.03	1.00	0.7	
Sago Pondweed	3.3	0.10	3.00	2.0	
Elodea sp	3.3	0.10	3.00	2.0	

Table 13: August 2006 Data Analysis: 5-10 Foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants					
Date:	8/30/06	Littoral sites with plants:	13	Species diversity:	0.69
Littoral depth (ft):	10.0	Number of species:	6	Native diversity:	0.66
Littoral sites:	20	Maximum species/site:	3	Rake diversity:	0.62
Total sites:	20	Mean number species/site:	1.00	Native rake diversity:	0.57
Secchi:	2.5	Mean native species/site:	0.95	*Mean rake score:	2.35
Common Name	Site frequency	Relative density	Mean density	Dominance	
Coontail	45.0	1.25	2.78	25.0	
Eel Grass	30.0	1.00	3.33	20.0	
Slender Naiad	10.0	0.10	1.00	2.0	
Eurasian Watermilfoil	5.0	0.15	3.00	3.0	
Large-leaf Pondweed	5.0	0.05	1.00	1.0	
Sago Pondweed	5.0	0.05	1.00	1.0	

Table 14: August 2006 Data Analysis: 10-15 Foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants					
Date:	8/30/06	Littoral sites with plants:	1	Species diversity:	0.50
Littoral depth (ft):	15.0	Number of species:	2	Native diversity:	0.50
Littoral sites:	10	Maximum species/site:	2	Rake diversity:	0.50
Total sites:	10	Mean number species/site:	0.20	Native rake diversity:	0.50
Secchi:	2.5	Mean native species/site:	0.20	*Mean rake score:	0.10
Common Name	Site	Relative density	Mean	Dominance	
	frequency		density		
Coontail	10.0	0.10	1.00	2.0	
Sago Pondweed	10.0	0.10	1.00	2.0	

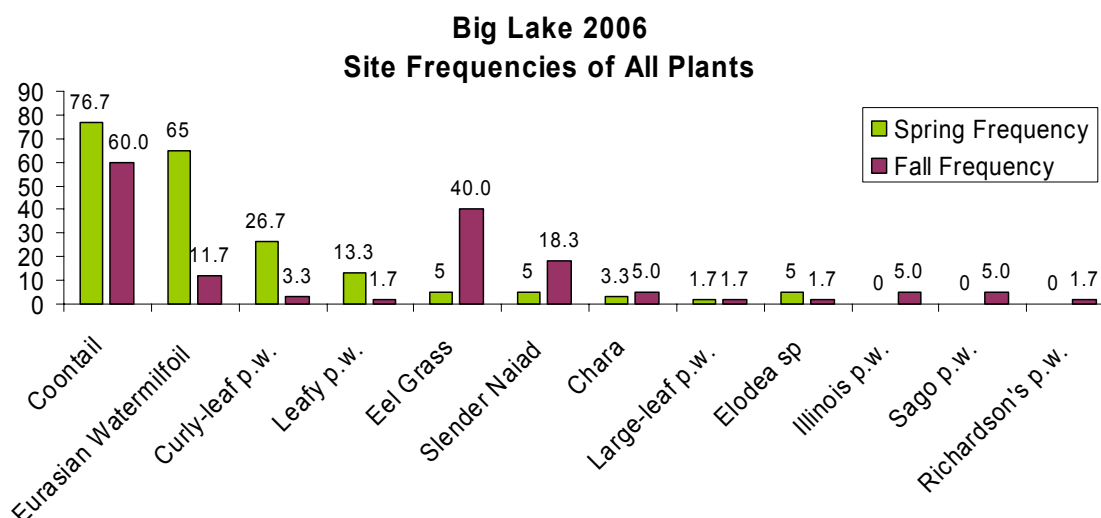
Site Frequency

Site frequency is a measure of how often a species was collected during the Tier II survey. It can be calculated by the following equation:

$$\text{Site Frequency} = \left(\frac{\text{\# of sites where the species was collected}}{\text{Total \# of littoral sample sites}} \right) \times 100$$

Table 15 shows site frequencies for every plant collected in both the spring and August Tier II Surveys. In the spring, coontail and Eurasian watermilfoil both had very high site frequencies. Coontail frequency remained very high in the August survey, but Eurasian watermilfoil frequency dropped from 65 % to just 11.7 %. Curly leaf pondweed frequency dropped from 26.7% in spring to just 3.3% in the August survey. Another notable change was in the slender naiad population as it rose from 5% in spring to 18.3% frequency in August. This is expected as slender naiad normally will not become abundant until the middle of July.

Table 15: Big Lake 2006 Site Frequencies



Mean Density and Relative Density

Mean Density is a measure the abundance of a species in areas where it is growing. For example, a species can have a high site frequency, but still have a very low mean density. This means that a species may be prevalent throughout an entire lake, but it may also be sparsely scattered. Mean density can be calculated using the following equation:

$$\text{Mean Density} = \frac{\text{(The sum of all rake scores for a species)}}{\text{(Total \# of sites where the species was collected)}}$$

Relative Density is calculated much like mean density, only in this case, the sum of the rake scores for a species is divided by the total number of sample sites in the survey. Unless a species was collected at every sample site, the relative density will always be smaller than the mean density.

$$\text{Relative Density} = \frac{(\text{The sum of all rake scores for a species})}{(\text{Total \# of littoral sample sites})}$$

Table 16 shows mean and relative densities in the spring of 2006. Coontail had both the greatest mean density and the greatest relative density. It was followed closely by Elodea which had a mean density of 2.33 but had a relative density of only 0.12 since it was found so sparingly. Eurasian watermilfoil and Curly-leaf pondweed were next with mean densities of 2.08 and 2.00 respectively. Leafy pondweed had a mean density of 1.25 while 4 other native species had a mean density of 1.

Table 16: Spring 2006 Mean and Relative Densities

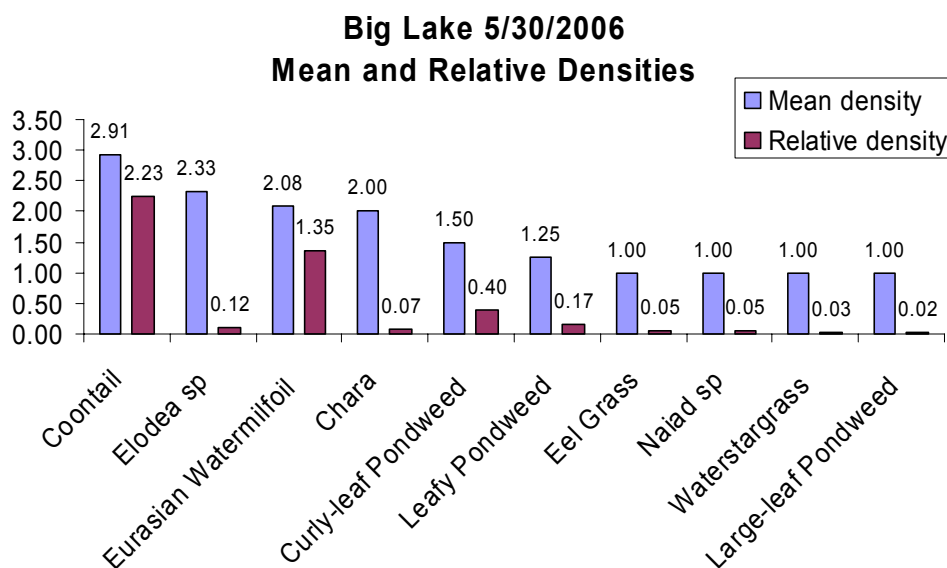
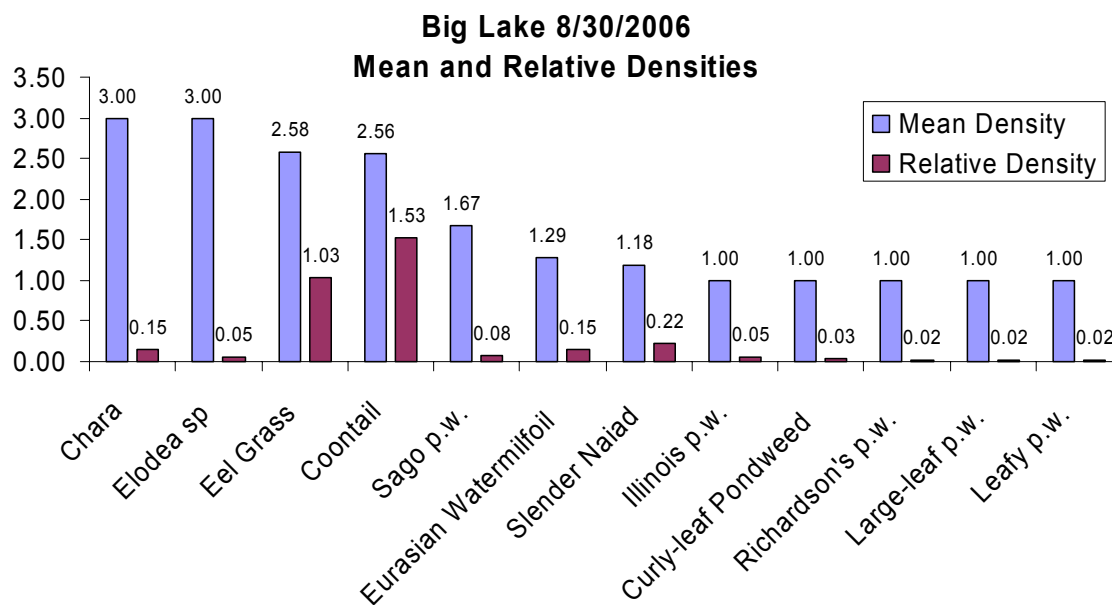


Table 17 shows densities in the August survey. Chara had the highest mean density in the August, but had a low relative density because of its low abundance in relation the other species. Coontail no longer had the greatest mean density, but still had the highest relative density of any plant at 1.53. Eurasian watermilfoil showed decreases in both mean and relative density with scores of 1.29 and 0.15. Eelgrass densities both increased, as it had the second highest relative density of any plant in the August survey (1.03).

Table 17: August 2006 Mean and Relative Densities



Species Diversity

The species diversity indices listed in Tables 7 through 14 help to describe the overall plant community. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that a chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

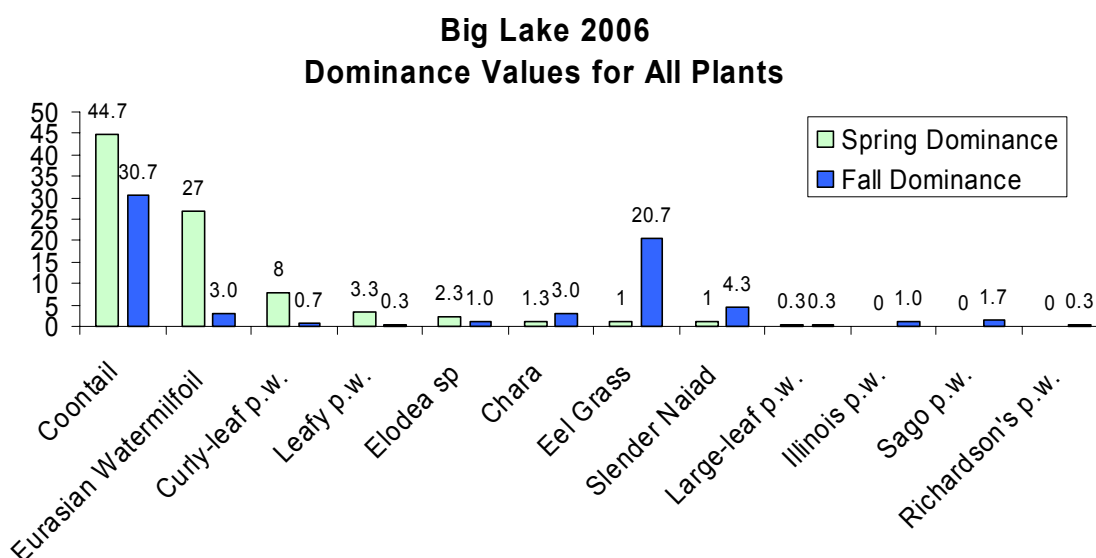
The species diversity index for Big Lake in the May survey was 0.74 while this diversity index increased slightly to 0.76 in the August survey. Many plants like eel grass and naiad are not prevalent until mid summer which likely helps account for higher diversity values late in the growing season. Native plant diversity in the May survey was measured at 0.52. This value is lower than the total species diversity, simply meaning that exotic species account for some of the diversity in Big Lake. Native diversity increased as well in the August survey, with a value of 0.71. Rake diversity was measured at 0.65 in the May survey, and increased slightly in the August survey to 0.69. Native rake diversity increased from 0.33 in May to 0.65 in August.

Species Dominance

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 18 shows dominance values for each plant collected in the 2006 Tier II surveys. Coontail was by far the most dominant plant in Big Lake in both spring and August. Eurasian milfoil had a very high dominance score in relation to most native species in the spring, although its dominance decreased in the August. Eelgrass dominance increased in the August survey, as it became the second most dominant plant by the end of August. Dominance scores of leafy pondweed, chara, elodea, and largeleaf pondweed (all natives) changed little from spring to August.

Table 18: 2006 Species Dominance



Relative Frequency of Occurrence

Relative frequency of occurrence is a measure of how often a plant is collected in relation to all of the other plants collected in a Tier II survey. It is demonstrated with the following equation:

$$\text{Relative Freq. of Occurrence} = \frac{\text{The site Frequency for a species}}{\text{The sum of all site frequencies including the species in question}} * 100$$

The sum of all relative frequency of occurrence values will always add up to 100. For this reason it is displayed in a pie graph.

Table 19 shows relative frequency values for each plant collected in the spring 2006 survey. Coontail had the highest relative frequency of occurrence at 37.4%, followed closely by Eurasian watermilfoil at 31.7 percent. Curly leaf pondweed was next, at 13.0% and leafy pondweed had a relative frequency of 6.5%. Six other species had relative frequencies of 2.4 or less.

Table 19: Spring 2006 Relative Frequencies of Occurrence

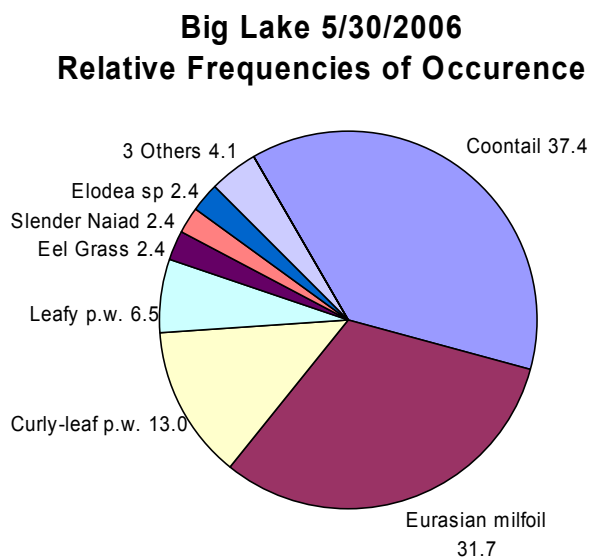
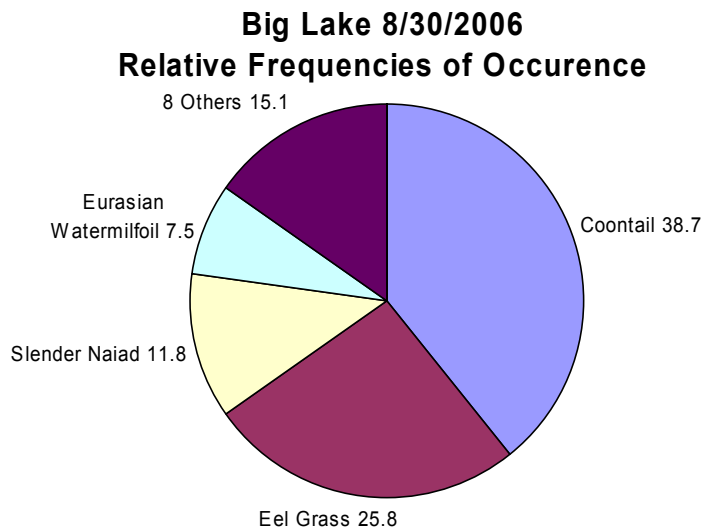


Table 20 shows relative frequency of occurrence values for each plant collected in the August 2006 survey. Coontail was again highest, with a relative frequency of 38.7%. This was almost identical to the spring survey. Eelgrass had replaced Eurasian watermilfoil with a relative frequency of 25.8%. Slender naiad had also increased to the third highest spot, with a relative frequency of 11.8%. Eurasian watermilfoil showed a large drop from the spring survey from 31.7% to 7.5 %. Eight other species had relative frequencies of 3.2 or below.

Table 20: August 2006 Relative Frequencies of Occurrence



8.3 Macrophyte Inventory Discussion

Submersed aquatic vegetation covers an estimated 40 acres, or 17.5% of Big Lake's total surface area. Significant wetland areas cover at least 17.5 acres, both in the lake, and on the surrounding shoreline area. Of the 40 acres covered with submersed plants, Eurasian milfoil was present throughout, being found in 5 of the six plant beds.

Based upon 2006 survey data, Big Lake has moderately diverse submersed aquatic plant community when compared with many area lakes, especially in relation to its low water clarity. Species richness in Big Lake was 10 species in the spring and 12 species in the August. The plant community is dominated by coontail and Eurasian watermilfoil in the spring. In the August eelgrass replaced Eurasian watermilfoil as one of the most dominant species along with coontail.

As more data is collected in the years to come, long term trends can be identified, and the health of the plant community can be more closely tracked. One of the most obvious trends in the 2006 data was a general decrease in Eurasian watermilfoil abundance from spring to August, along with the increase in eelgrass dominance from spring to August.

Native diversity and overall diversity increased slightly from spring to August, although the average number of species collected at each site dropped slightly from 2.05 to 1.55. Overall biomass appeared to increase as well from spring to August, as many plants showed increased in mean density.

The large emergent plant beds in the second and third basin of Big Lake should be protected if possible. They provide excellent water filtration and may help prevent further declines in water quality.

In summary, the Big Lake is characterized by a fairly diverse submersed plant community (12 species), low water clarity (secchi depth 2.5-3.5 ft.) a widespread distribution of Eurasian milfoil in the spring (site frequency 65% in spring, 11.7% in August) and an increase in native dominance as the growing season progresses.

9.0 Aquatic Plant Management Alternatives

Big Lake currently has Eurasian watermilfoil distributed throughout the lake. Eurasian milfoil is believed to have arrived in North America in the mid 1940's and has spread throughout the east coast to northern Florida and the Midwest. Eurasian milfoil spreads by fragmentation and seed dispersal, and it has the ability to over-winter from year to year. Once it is in a lake it can become the dominant plant species because it forms dense canopies which shade out the native, more beneficial plant species below. There is also increasing evidence that mat forming species like Eurasian milfoil and curly leaf pondweed exert significant negative impacts on a broad range of aquatic organisms (Pullman, 1998)

Many management strategies have been used to control Eurasian milfoil in Indiana lakes. A management strategy should be chosen based on its selectivity of the pest in question, its long term effectiveness, and its environmental risks. The main goal of this plan is to choose a management option that can effectively control the Eurasian milfoil with little or no environmental risk, while causing no harm to native plant or fish species.

9.1 No Action

If no action is taken, the Eurasian milfoil abundance will increase from year to year. Eurasian milfoil grows by fragmentation, meaning that if the plant is cut, the fragment has the ability to form an entirely new plant. Eurasian milfoil also over-winters as an adult plant so new generations are created in each growing season. These reproductive characteristics cause milfoil beds become more dense over time, which can create a monoculture as it may eliminate more and more native species from a lake.

9.2 Institutional-Protection of Beneficial Vegetation

Lake users can play an important role in the protection of beneficial aquatic vegetation. Aquatic invasive species often gain a foothold in an ecosystem in areas disturbed by human activity or natural processes. In many cases, boating may be restricted in certain areas of a lake to prevent harm to native plants, especially many emergent species. Boating lanes may be established through areas of emergent vegetations, and protected ecological zones may be created to prevent erosion off shoreline vegetation caused by intense wave action from boating activities. Shallow areas of a lake may also be marked with buoys to prevent injury to boaters and water skiers. It is important to obey boating restrictions to protect beneficial plant species and even prevent personal injury.

A healthy aquatic plant community is absolutely essential for the maintenance of a stable, diverse ecosystem. Aquatic plants provide habitat for plankton, insects, crustaceans, fish, and amphibians. They take nutrients like phosphorus and nitrogen out of the water column, increase water clarity, prevent harmful algal blooms, produce oxygen and provide food for waterfowl. Aquatic plants can even remove pollutants from contaminated water, and prevent the suspension of particulate matter by stabilizing sediment and preventing erosion from wave action or current.

The LARE aquatic vegetation management program recognizes the importance of beneficial aquatic vegetation and its protection is a top priority. The most basic goal for the LARE aquatic vegetation program is to maintain healthy aquatic ecosystems by maintaining or

improving biodiversity in Indiana lakes. The purpose of conducting aquatic vegetation surveys is to document the overall health of plant communities and identify any ecosystem whose stability is threatened by invasive plant species.

Once a problem area is identified, a management strategy must be formulated that directly impacts the aquatic plant community in a positive way. While eradicating invasive plants is a major component of many management strategies, it is important to note the ultimate goal is not to eradicate aquatic vegetation, but to protect beneficial vegetation and protect lake ecosystems.

9.3 Environmental Manipulation

9.3.1 Water Level Manipulation

Draw down of the lake water level is one option that may help the Eurasian milfoil problem. Lower water levels expose the Eurasian milfoil roots to freezing and thawing, which may kill milfoil root systems. However, a lake draw down will not only kill Eurasian milfoil, but native plants as well. Also, reducing the lake level would make new areas of the lake available for vegetative growth, and Eurasian milfoil may have an advantage in the colonization of these new areas if it is not eradicated prior to the lake draw down.

9.3.2 Nutrient Reduction

Limiting factors for plant growth include light, lake morphometry and depth, substrate and the availability of nutrients like phosphorus and nitrogen. While lake morphometry is most highly correlated with plant biomass, the availability of phosphorus and nitrogen have a tremendous impact on the amount of plant growth in a body of water. If the vast majority of phosphorus in a system is tied up in plant matter, it may be difficult for an invasive species to gain a foothold and spread rapidly in the lake. If phosphorus is constantly being added to the system and is readily available in the water, then invasive species will have an unlimited food supply should a disturbance create the opportunity for them to proliferate in a body of water.

Phosphorus and nitrogen are added to aquatic systems by many natural sources, such as the



www.epa.gov

decomposition of plant material, and animal waste, but human activity is often responsible for excessive phosphorus loading that contributes to blue-green algal blooms, overabundant vegetation growth and a general decline in water quality. Major contributions of excess phosphorus come from sources such as septic

system inputs, agricultural runoff, storm water drainage, lawn fertilizer applications, , and improper disposal of grass clippings and tree leaves. Owners of lake front property can significantly reduce the amount of phosphorus entering the lake by taking actions outlined in the public education section.

9.4 Mechanical Controls

9.4.1 Mechanical Cutting and Harvesting

Mechanical harvesting uses a large machine to cut and collect unwanted aquatic plants. These machines pick up the cut weeds but will still leave small fragments that will have the ability to re-grow. Also, after an area is harvested the Eurasian milfoil generally re-grows



www.cleanlake.com

first causing the native plants to be shaded out again. Mechanical harvesting is also not selective in its control. The harvesting will cut the native plant species as well as the exotics if both are present in the same area. For these reasons, mechanical harvesting is not recommended. Harvesting can be accomplished by individual owners around their dock areas. A lake property owner can legally harvest a 625 square foot area. (25 feet by 25 feet).

9.5 Manual Controls

9.5.1 Hand Pulling, Cutting, Raking



www.ecy.wa.gov

Manual controls such as hand pulling, cutting and raking can be effective ways to control unwanted plants in certain situations. In very shallow clear water, small areas of vegetation can be identified and cleared effectively by hand. Large areas of vegetation, especially those in deeper water can be extremely difficult to control using these methods. Many of the harvested weeds will break apart, leaving the root system in the lake bottom. Failure to remove root structures will result in re-growth.

Plants that possess the ability to reproduce through fragmentation can seldom be effectively controlled by these methods if they are distributed throughout a lake. Identifying every area of infestation would be difficult, as would harvesting the plants without causing fragmentation of individual plants. Any plant fragments not removed from the water can form new plants, meaning that hand pulling and cutting can facilitate the spread of the unwanted plant species.

9.5.2 Bottom Barriers

Bottom Barriers prevent the growth of aquatic plants by lining the bottom of a lake or pond with a material that prohibits light from reaching the lake bottom and that is difficult for



plants to penetrate. Many times, plastic or concrete barriers are used to prevent the growth of aquatic vegetation during construction of a lake or pond. This form of control is best implemented during construction of a new pond, and placing a bottom barrier in an existing lake would involve significant challenges and be extremely expensive. A draw down of the lake may be necessary install the barrier, and if the lake level is not regulated by control structures, this can be almost impossible.

For a large lake, material costs alone would be enormous.

Once in place, the barrier would prevent not only invasive plant growth, but native plant growth as well, destabilizing the lake ecosystem and having a negative impact on insect and fish communities. Sediment would gradually accumulate on top of the barrier, and aquatic plant growth would return as plants begin to take root in the sediment on top of the barrier. An IDNR permit is required for the placement of a bottom Barrier.

9.6 Biological Controls

9.6.1 Water Milfoil Weevil



The watermilfoil weevil is a native North American insect that consumes Eurasian milfoil and northern milfoil. The weevil was discovered after a decline in the Eurasian milfoil population was observed in Brownington Pond, Vermont (Creed and Sheldon, 1993). The milfoil weevil burrows down into the stem of the plant and consumes the tissue of the plant. Holes in the milfoil stem bored by weevil larvae allow disease to

enter the plant. These same holes also cause a release of the plants' gases which reduces buoyancy and causes the plant to sink (Creed et. Al. 1992).

Studies conducted to evaluate the effectiveness of the water milfoil weevil have not yielded consistent results. Factors influencing the weevil's success or failure in a body of water are not well documented. In 2003, Scribailo and Alix conducted a weevil test on Round Lake in Indiana and found no conclusive evidence that the Eurasian milfoil populations were reduced. An IDNR permit is required for the stocking of the watermilfoil weevil.

9.6.2 Grass Carp

The Asian grass carp or white amur (*Ctenopharyngodon idella*) is an herbivorous fish that is native to eastern Russia and China. This fish has been introduced into the U.S. to help control aquatic vegetation. To prevent their uncontrolled proliferation, all fish stocked in Indiana must be triploid, meaning that they cannot reproduce. Stocking is restricted to



www.tpwd.state.tx.us

privately owned bodies of water, and suppliers must obtain a special permit from the IDNR. Grass carp are completely vegetarian, feeding on many species of submersed plants, along with some floating plants such as duckweed. Hydrilla, a highly invasive plant found in

many southern states is a preferred food of grass carp and efforts to control hydrilla with grass carp have been successful.

According to the Aquatic Ecosystem Restoration Foundation, grass carp avoid Eurasian milfoil, and show strong preferences for many native plants along with hydrilla. The success of grass carp stockings is highly dependent upon the food sources available to the fish. When Eurasian milfoil occurs along with native plant populations, grass carp are not recommended. Grass carp are not currently permitted for stocking in public waters.

9.7 Chemical Controls

9.7.1 Aquatic Herbicides

There are two major categories of aquatic herbicides: contact and systemic herbicides. Contact herbicides are used best to control the majority of the weeds close to shore, around piers and in man-made channels. Examples of contact herbicides are Reward (active ingredient: diquat), and Aquathal (active ingredient: endothal).

Contact herbicides would not be a wise choice for a whole lake treatment because of their lack of selectivity and their inability to eliminate the root systems of treated plants. These characteristics could result in unnecessary damage to native species, as well as greater potential for the re-infestation of Eurasian milfoil.

Systemic herbicides are absorbed by the plant and transported to the root systems where they eliminate both the roots and the plant. Examples of systemic herbicides are Sonar and Avast (active ingredient: fluridone), Navigate, Aqua Kleen, DMA4 (active ingredient 2, 4-D) and Renovate (active ingredient: triclopyr). All of these chemicals effectively kill Eurasian milfoil plants and roots. Based on the author's experience and other lake managers in the Midwest, whole lake treatments using fluridone are the most effective way to control Eurasian water milfoil in lakes that have become severely infested. Fluridone can be applied at low rates to control the Eurasian milfoil while causing little or no harm to the majority of the native weed species present in the lake.

2, 4-D and Renovate (active ingredient: triclopyr) are both root control herbicides which can be used for spot treatments in small areas of Eurasian milfoil infestation, while the whole

lake must be treated if Sonar (fluridone) is used. The major difference between 2, 4-D and triclopyr is that triclopyr may have the ability to control the Eurasian milfoil longer than 2,4-D. Renovate (triclopyr) has only been available for use for the past three seasons, and the ability of Renovate to provide more long term control of Eurasian milfoil than 2,4-D in spot treatment situations is still being documented. 2, 4-D is less expensive to use but if triclopyr shows better long term control in treated areas it may become the most cost effective long term investment.

The public's primary concern with the use of aquatic herbicides is safety. Every chemical registered for aquatic applications has undergone extensive testing prior to becoming available for use. These tests demonstrate that when these herbicides are applied properly at labeled rates, they are safe for humans and will not directly cause any adverse environmental effects.

10.0 Public Involvement

Table 21 summarizes the public questionnaire data received from input at public meetings. Questionnaires were handed out to all in attendance at the public meeting, held on October 24, 2006. Turn out was excellent, with 28 people in attendance. The Big Lake Association is very active, and privately funded herbicide treatments have been conducted on Big Lake in the past, especially in the first basin. Residents were excited about the possibility of receiving LARE funding to aid in the control of invasive species in Big Lake. Data was compiled and the original questionnaire was used to show a summary of all responses.

Table 21: Big Lake Public Questionnaire

Total: 28

Lake Use Survey Lake name Big Lake

Are you a lake property owner? Yes 26 No 2

Are you currently a member of your lake association? Yes 22 No 5

How many years have you been at the lake? 2 or less - 2
2 - 5 years - 7
5-10 years - 5
Over 10 years - 14

How do you use the lake (mark all that apply)

<u>24</u> Swimming	<u>1</u> Irrigation
<u>26</u> Boating	<u>1</u> Drinking water
<u>28</u> Fishing	<u>0</u> Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 27 No 1

Do you currently participate in a weed control project on the lake? Yes 16 No 10

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 26 No 1

Does the level of vegetation in the lake affect your property values? Yes 20 No 2

Are you in favor of continuing efforts to control vegetation on the lake? Yes 28 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 22 No 4

Mark any of these you think are problems on your lake:

<u>2</u>	Too many boats access the lake
<u>7</u>	Use of jet skis on the lake
<u>1</u>	Too much fishing
<u>6</u>	Fish population problem
<u>7</u>	Dredging needed
<u>6</u>	Overuse by nonresidents
<u>20</u>	Too many aquatic plants
<u>1</u>	Not enough aquatic plants
<u>12</u>	Poor water quality
<u>0</u>	Pier/funneling problem

Please add any comments:

too many bass clubs; week of October 9 there was a fishy chemical smell; has anyone checked to see if herbicides from surrounding farms have seeped into the lake? the meeting should be during the summer so that more people can vote.

11.0 Public Education

Lake residents play an important role in establishing and maintaining a healthy lake community. Lake association meetings and newsletters are excellent avenues through which this information about management practices on Big Lake can be distributed. These meetings can also help to inform the public about practical steps that they can take to improve Big Lake. The following information is designed to give practical suggestions on ways that lake residents can reduce nutrient loading and improve the Big Lake ecosystem.

1. **Ensure that existing homes be connected to a properly maintained lake wide sewer system if possible.** Many older homes possess septic systems without proper filter beds. Some systems may have significant leaks, while some may drain into the lake. Sewage leaks add tremendous amounts of nutrients to the water, along with harmful bacteria. If a lake does not have a sewer system, the proper maintenance of septic tanks and filter beds can help reduce nutrient loading.
2. **Limit lawn fertilizer use in areas where runoff will enter the lake.** If a fertilizer application must be applied, avoid spreading fertilizer directly into the lake, on sidewalks, or sea walls where it will wash into the lake. Try to avoid applying fertilizer within 30 feet of the shoreline. If fertilizer must be used, low phosphorus or no phosphorus fertilizer is preferred for use.
3. **Work with farmers within the lake catchment to increase proper filtration and drainage of agricultural land before runoff reaches the lake.** The Indiana state government offers incentives for farmers to address soil and water concerns through the U.S. Department of Agriculture. The Indiana Conservation Reserve Program (CRP) provides technical and financial aid to reduce soil erosion, reduce sediment in lakes and streams, and improve overall water quality. Farmers owning highly erodible land or property adjacent to tributary streams or lakes may be eligible for funding that can increase water quality significantly. Further information can be found at www.in.nrcs.usda.gov/programs/CRP/crphomepage.html or by contacting the following address.
 Indiana NRCS
 6013 Lakeside Boulevard
 Indianapolis, Indiana 46278-2933
 Phone: (317) 290-3200
 FAX: (317) 290-3225
4. **Avoid blowing grass clippings and tree leaves into the lake.** Many pond owners know that grass clippings blown into a pond can turn into a floating mat of algae in only a few days. This occurs because cut and decaying vegetation rapidly releases nutrients into the water.
5. **Prevent or reduce urban and industrial runoff flowing directly into the lake.** Urban runoff can be one of the most detrimental factors influencing water quality. Not only are nutrients and sediment carried to lakes through storm sewers, but harmful contaminants as well. Oil, antifreeze, gasoline, road salt, and other

pollutants are washed from pavement and can all end up harming a lake ecosystem.

The following are practical steps recommended by the United States Environmental Protection Agency to reduce urban runoff:

- a) Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss.
- b) Limit land disturbance such as clearing and grading and cut fill to reduce erosion and sediment loss.
- c) Limit disturbance of natural drainage features and vegetation.
- d) Place bridge structures so that sensitive and valuable aquatic ecosystems are protected.
- e) Prepare and implement an approved erosion control plan.
- f) Ensure proper storage and disposal of toxic material.
- g) Incorporate pollution prevention into operation and maintenance procedures to reduce pollutant loadings to surface runoff.
- h) Develop and implement runoff pollution controls for existing road systems to reduce pollutant concentrations and volumes.

Further information about urban runoff in Indiana can be obtained by contacting the EPA Region 5 National Pollution Discharge Elimination System Storm Water Coordinator by calling (312) 886-6100.

6. **Establish ecological zones to protect existing wetlands and emergent vegetation from turbulence caused by boats.** Wetlands not only filter water, but they also stabilize shoreline areas that would otherwise be highly erodible. Submersed and emergent vegetation can be eliminated by heavy wave action, which destabilizes the shoreline and reduces the lake's natural defense against sediment and nutrient loading. It is extremely important to make sure that existing wetlands remain intact to aid in the natural water purification process. If possible lake associations should identify significant wetland areas and work with the IDNR to protect them from drainage and disruption.

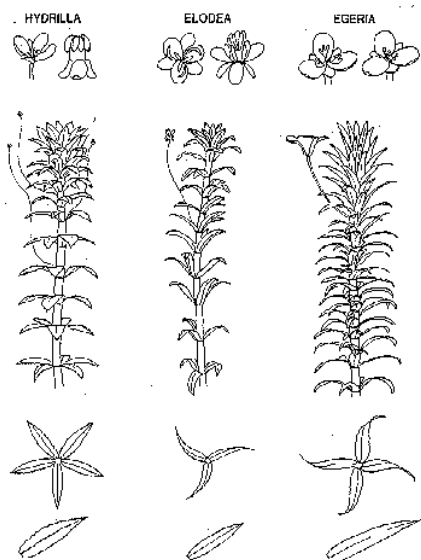
Hydrilla

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic plant species common throughout the southern United States. It is federally listed as a noxious weed and causes severe ecological and recreational problems wherever it grows. It is considered to be much more destructive than other invasives like Eurasian watermilfoil and curly leaf pondweed because of its reproductive adaptations. It grows by fragmentation, as does Eurasian watermilfoil, but it also produces turions which can remain dormant in the sediment for 4 years or more (Van and Steward, 1990). It produces tubers at its root tips which can also reproduce after multiple years of dormancy. It can grow 1 inch each day and it quickly out-competes native plants. It forms dense beds that eliminate native plants, stunt fish populations, impede recreation and cause a drastic decrease in biodiversity (Colle and Shireman, 1980). Millions of dollars are spent each year for hydrilla maintenance each year in Florida alone.



Eradication is unlikely once a population has been well established, although eradication has been achieved in

newly infested waters using a herbicide called Sonar. Sonar is applied at a rate of 6 parts per billion and this concentration is maintained in the water for 180 days. Early detection can be



crucial to an effective eradication program, and all lake residents and users are encouraged to be on the look-out for this invader. In fall of 2006, this plant was found in Lake Manitou, in Rochester, Indiana. This is the first instance of hydrilla in the upper Midwest. Prior to its appearance in Lake Manitou, The closest infestations of hydrilla were in Tennessee and Pennsylvania.

Hydrilla can easily be confused with native elodea. The major difference is that elodea has sets of leaves on the stem in whorls of three, while hydrilla usually has whorls of 5 leaves, although 4 to 9 leaves per whorl are possible with hydrilla. Hydrilla will also have small serrations on the leaf edges. More information on hydrilla can be found at the University of Florida's Center for Aquatic Invasive Plants (<http://plants.ifas.ufl.edu/>). More general

information on aquatic invaders can be found at www.protectyourwaters.net.

12.0 Integrated Treatment Action Strategy

Given Eurasian watermilfoil abundance in Big Lake, funding may be awarded by the LARE program to chemically treat areas of infestation. Chemical treatment options for selective, root control of Eurasian watermilfoil include Sonar, Renovate, and 2, 4-D. Sonar treatments provide the most complete control of Eurasian watermilfoil and can also provide multiple years of control. Renovate and 2, 4-D, while very effective, are normally applied to the same areas on a yearly basis to provide control.

Based on meetings with IDNR fisheries and LARE biologists, Aquatic Weed Control's initial request for a whole lake Sonar treatment will not be granted in 2007. IDNR biologists would prefer to further analyze results from other ongoing Sonar projects in Indiana prior to its use in Big Lake. However, Big Lake may be considered as a candidate for a Sonar treatment in future years, pending the results of those other projects.

The 2007 treatment plan will use a combination of 2, 4-D and Renovate to provide control of Eurasian watermilfoil. Exact treatment areas will depend upon results of a spring 2007 vegetation survey, and up to 40 acres of Big Lake may be treated to reduce the Eurasian watermilfoil population.

2, 4-D will be used in the first and largest basin of Big Lake. Renovate will be used in basins 2 and 3. Using Renovate in basins 2 and 3 will protect native coontail, as 2, 4-D can achieve some control on the native coontail. Using 2, 4-D in basin #1 will lower costs significantly and limit potential areas of coontail damage to the area of highest recreational use.

No other herbicide treatments are likely to be permitted by the IDNR at Big Lake in 2007 aside from the LARE funded herbicide treatment.

This chemical treatment should not be considered a "one time treatment." Renovate and 2, 4-D provide effective control, but seldom does it last for multiple years. These treatments will likely occur once each year, for as long as this course of action is implemented.

Using 2, 4-D and Renovate in different basins of Big Lake will also provide a good basis on which to evaluate the effectiveness and selectivity of the 2 herbicides, as Renovate is a relatively new product, and both herbicides are commonly used to treat Eurasian watermilfoil with LARE funding.

It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will be awarded only for the control of invasive plant species. The goal is not to eliminate vegetation in Big Lake, but to improve the health of the plant community. Residents and lake users should not expect any dramatic decline in native vegetation. The major objective of this project will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

13.0 Project Budget

Cost estimates for this project are included in Table 22. These figures are estimates only and are subject to change pending 2007 chemical pricing. Cost figures will be very similar for 2008 if the action plan remains the same. Again prices will vary pending 2007 and 2008 chemical pricing.

Table 22: 2007 Cost Estimates

Project	Total Cost	LARE Share	Association Share
Treat up to 18 acres in Basin #1 with 2, 4-D	\$6,480	\$5,832	\$648
Treat up to 22 acres in Basins #2 and #3 with Renovate	\$10,450	\$9,405	\$1,045
2007 Plant Surveys and Plan update	Up to \$4,000	Up to \$3,600	Up to \$400
Totals	\$20, 930	\$18,837	\$2,093

Survey and planning costs

Four thousand dollars are currently budgeted for surveying and planning (Table 22) but this cost may be reduced pending 2007 LARE survey and planning requirements.

14.0 Monitoring and Plan Update Procedures

Two Tier II vegetation surveys will be conducted on Big Lake in 2007. One will take place prior to chemical treatment and the other will take place after the treatment. The post treatment survey should be conducted in late summer to allow the slow acting herbicides to achieve full control before the survey is conducted.

In the years that follow, additional surveys should be conducted to determine how the Eurasian milfoil population is reacting to the management strategy over a long period of time. These surveys will provide a basis for evaluation of the management strategy and can be presented to the public should the need arise to modify the management strategy. They will also serve to keep the public interested and informed about management practices at the lake so they will be motivated and equipped to actively participate in the conservation of the Big Lake ecosystem. The intensity and frequency of vegetation surveys may change from year to year. Survey and planning needs should be re-evaluated each year to reduce unnecessary cost to the lake association while still providing adequate data to characterize the plant community.

15.0 References

Blessing, Arlene. 2004. Fundamentals of Pesticide Use: Indiana Pesticide Applicator Core Training Manual. Purdue University. West Lafayette, Indiana 106 pp.

Cunningham, Willam P., and Saigo, Barwbara W. 2001. Environmental Science: a Global Concern. McGraw Hill Inc. Boston, Massachusetts 646.

Getsinger, Kurt Ph.D. 2005. Aquatic Plant Management: Best Management Practices in Support of Fish and Wildlife Habitat. The Aquatic Ecosystem Restoration Foundation. 78 pp.

IDNR. 2004. Procedure Manual for Surveying Aquatic Vegetation: Tier I Reconnaissance Surveys. IN Department of Natural Resources, Division of Soil Conservation.

IDNR. 2004. Procedure Manual for Surveying Aquatic Vegetation: Tier II Reconnaissance Surveys. IN Department of Natural Resources, Division of Soil Conservation.

Kalff, Jacob. 2002. Limnology: Inland Water Ecosystems. Prentice Hall. Upper Saddle River, New Jersey. 592 pp.

Kannenburg, James R., and Schmidt, James C. 1998. How to Identify and Control Water Weeds and Algae: 5th edition. Applied Biochemists. Milwaukee, Wisconsin. 128pp.

Koza, Larry. 2002. Big Lake: Lagrange County Fish Management Report. Indiana Department of Natural Resources Division of Fish and Wildlife.

LARE 1995. A Preliminary Assessment of Big Lake In Noble County. IDNR Lake and River Enhancement Program. Division of Fish and Wildlife.

Lembi, Carole 1997. Aquatic Pest Control: Category 5. Department of Botany and Plant Pathology: Purdue University. West Lafayette, Indiana. 58pp.

Pearson, Jed. 2000. Big Lake Fisheries Survey. IN Department of Natural Resources. Division of Fish and Wildlife.

Pearson, Jed. 2004. A Proposed Sampling Method to Assess Occurrence, Abundance and Distribution of Submersed Aquatic Plants in Indiana Lakes. IN Department of Natural Resources. Division of Fish & Wildlife.

Pullman, Douglas G. 1998. The Lake Association Leaders Aquatic Vegetation Management Guidance Manual.

Scribailo, Robin W. Ph.D. & Alix, Mitchell S. 2003. Final Report on the Weevil Release Study for Indiana Lakes. Department of Botany and Plant Pathology. Purdue University. West Lafayette, IN.

Smith, Robert Leo and Smith, Thomas M. 2001. Ecology and Field Biology. Addison Wesley Longman, Inc. San Francisco, California. 771 pp.

Stern, Kinsingly R. 2000. Introductory Plant Biology. McGraw Hill. Madison, Wisconsin. 557 pp.

Tyllia, J. 2000. Northeastern Indiana Fishing Map Guide. Superior, Wisconsin. 184 pp.

16.0 Appendices

16.1 Calculations

Fluridone Calculations:

The following paragraph is taken directly from the Sonar A.S. label. It outlines the specific procedures for calculating the amount of Fluridone needed to treat a body of water.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar A.S. to be applied to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:

Quarts of Sonar A.S. required per treated surface acre =
Average water depth of treatment site (feet)

x Desired ppb concentration of active ingredient

x 0.0027

For example, the quarts per acre of Sonar A.S. required to provide a concentration of 25 ppb of active ingredient in water with an average depth of 5 feet is calculated as follows:

$5 \times 25 \times 0.0027 = 0.33$ quarts per treated surface acre

When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured x 32. For example, 0.33 quarts x 32 = 10.5 fluid ounces.

Note: Calculated rates should not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

16.2 Common Aquatic Plants of Indiana

The following appendix was compiled using information found in the 5th edition of *How to Identify Water Weeds and Algae*, edited by James C. Schmidt and James R. Kannenberg. All pictures, with the exception of Illinois pondweed and northern milfoil were taken from the *Category 5 Aquatic Pest Control Management Manual*, written by Dr. Carole Lembi, Head of the Department of Botany and Plant Pathology at Purdue University.

American Pondweed



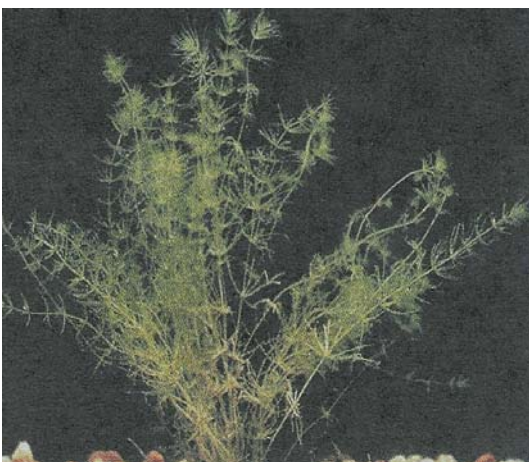
Scientific name: *Potamogeton americanus*

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: American pondweed can be identified by its oval shaped leaves floating on the top of the water. The base of each leaf tapers to a very long petiole that connects the leaf with the stem of the plant. Plant leaves are arranged alternately on the stem and leaves are usually sparsely scattered.

Chara



Scientific name: *Chara sp.*

Classification: Native to Indiana

Distribution: Extremely common worldwide. Usually found in hard water.

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that

may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches itself to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

Coontail



Scientific name:	<i>Ceratophyllum demersum</i>
Classification:	Native to Indiana
Distribution:	Common throughout the U.S., usually in hard water.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed

beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

Curley Leaf Pondweed



Scientific name:	<i>Potamogeton crispus</i>
Classification:	Exotic to Indiana
Distribution:	Found throughout the U.S. in fresh and brackish water.

Description: Curley leaf pondweed usually grows and spreads rapidly in early spring and begins to die out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curley leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A

reproductive spike may be seen protruding from the surface of the water. Curley leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and then sprout when spring arrives.

Eel Grass (Wild Celery)



Scientific name: *Vallisneria Americana*

Classification: Native to Indiana

Distribution: Found from the Great Plains to the East Coast of the U.S.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer and sit on the top of a coiled structure protruding to the surface. This plant is

found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

Elodea



Scientific Name: *Elodea Canadensis*

Classification: Native to Indiana

Distribution: Common throughout the north and north central united states. Its ranges extends as far south as northern Tennessee.

Description: Elodea grows in long strands resembling milfoil, but its leaves are broad and oval shaped. Leaves are arranged in whorls with three leaves usually occurring at each node. Leaves near the tip of the plant are closely packed together, with the distance between nodes increasing further down the stem.

Eurasian Milfoil



Scientific Name: *Microphyllum spicatum*

Classification: Exotic in Indiana

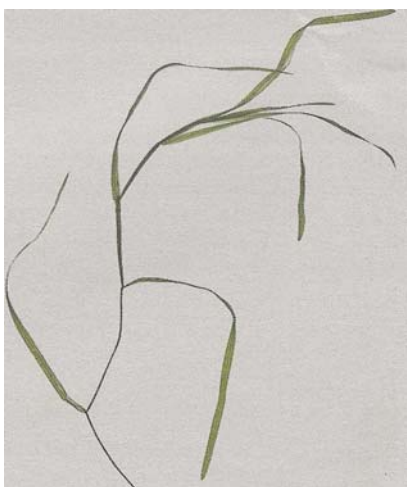
Distribution: Common in the Midwest and Eastern U.S. Also spreading along the Pacific coast

Description: This extremely aggressive and extremely destructive plant has leaves in whorls of 4 around a reddish stalk. This plant grows rapidly and can reach lengths of over 10 feet. This plant has the ability to overwinter, meaning it can lie dormant during the winter months instead of dying out completely each year. This

gives it a distinct advantage over many native species, as it competes for sunlight in early spring. The dormant milfoil plants reach the surface much faster than the native plants sprouting from the lake bottom. This enables the Eurasian milfoil to shade out other plants and form the dense beds that choke the littoral zone of many lakes.

A reproductive process called fragmentation aids the rapid dispersion of Eurasian milfoil. If a milfoil plant is damaged and some fragments are removed from the macrophyte, each small piece of the plant has the ability to grow roots and create a new milfoil plant. Eurasian milfoil is considered one of the most dangerous aquatic nuisance species because of its ability to rapidly disrupt and destroy lake ecosystems.

Flat-stemmed Pondweed



Scientific Name: *Potamogeton zosteriformis*

Classification: Native to Indiana

Distribution: Common throughout the northern half of the U.S.

Description: the most noticeable characteristic is the large, very flat stem. It cannot be rolled between the fingers easily. The ribbon-like leaves extend from the stem toward the surface of the water.

Illinois Pondweed



Scientific name: *Potamogeton illinoensis*

Classification: Native to Indiana

Distribution: Very widespread and very common throughout the upper Midwest and the U.S

Description: Illinois pondweed is common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

www.wvu.edu

Large Leaf Pondweed

Scientific name: *Potamogeton amplifolius*

Classification: Native to Indiana

Distribution: Common throughout the upper Midwest and the northern United States in hard water.

Description: This plant has both submersed and floating leaves. The floating leaves are oval shaped and are similar to those of American pondweed. Submersed leaves are arranged alternately with each leaf becoming extremely narrow as it nears the stem of the plant. Mineral deposits on its leaves often give large leaf pondweed a dark brown appearance.

Naiad



Scientific name: *Najas minor* (brittle naiad)

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have

multiple spines along the margins that are visible to the naked eye.

Nitella



Scientific name: *Nitella sp.*

Classification: Native to Indiana

Distribution: Found worldwide, usually in hard water.

Description: Nitella is very similar to chara, and it is also an advanced form of algae. It has leaf-like projections that are whorled around the stem. It is often found growing in very thick patches, usually in shallow, clear water.

Northern Milfoil



Scientific name: *Myriophyllum sibiricum*

Classification: Native to Indiana

Distribution: Found throughout the northern half of the U.S. and also in Europe and Western Asia

www.io.uwinnipeg.ca

Description: Northern milfoil has submersed, feather-like, whorled leaves that closely resemble the leaves of Eurasian milfoil. Distinguishing the native northern milfoil from Eurasian milfoil can be difficult. The leaflet pairs of northern milfoil are generally fewer and more widely spaced than those of Eurasian milfoil. This plant is known to hybridize with Eurasian milfoil, and at times, chemical analysis is necessary to distinguish between the two plants.

Sago Pondweed



Scientific name: *Potamogeton pectinatus*

Classification: Native to Indiana

Distribution: Found throughout the U.S.,
Common in the northern 2/3 of
Indiana.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water.

While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

16.3 Pesticide Use Restrictions Summary:

The following table was produced by Purdue University and included in the Professional Aquatic Applicators Training Manual. It gives a summary of water use restrictions on all major chemicals available for use in the aquatics market.

Table 23: Pesticide Use Restrictitons

Table 1. Aquatic Herbicides and Their Use Restrictions. Always check the label because these restrictions are subject to change.

	Human			Animal	Irrigation		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
	----- waiting period, in days -----						
Copper Chelate	0	0 ^a	0	0	0	0	0
Copper Sulfate	0	0 ^a	0	0	0	0	0
Diquat	1-3	0 ^a	0	1	1-3	1-3	5
Endothall (granular) ^b	7	0 ^a	3	0	7	7	7
Endothall (liquid) ^b	7-25	0 ^a	3	7-25	7-25 ^d	7-25	7-25
Endothall 191 (granular) ^c	7-25	0 ^a	3	7-25	7-25	7-25	7-25
Endothall 191 (liquid) ^c	7-25	0 ^a	3	7-25	7-25	7-25	7-25
Fluridone	0 ^e	0 ^a	0	0	7-30	7-30	7-30
Glyphosate	0 ^e	0 ^a	0	0	0	0	0
2,4-D (granular)	*	0 ^a	0	*	*	*	*

^aAlthough this compound has no waiting period for swimming, it is always advisable to wait 24 hours before permitting swimming in the direct area of treatment.

^bTrade name is Aquathol®.

^cTrade name is Hydrothol®.

^dMay be used for sprinkling bent grass immediately.

^eDo not apply this product within 1/4 (fluridone) to 1/2 (glyphosate) mile upstream of potable water intakes.

*Do not use treated water for domestic purposes, livestock watering (2,4-D, dairy animals only), or irrigation.

16.4 Public Input Questionnaire Data

Table 24: Public Questionnaire Sample

Total: 28

Lake Use Survey Lake name Big Lake

Are you a lake property owner? Yes 26 No 2

Are you currently a member of your lake association? Yes 22 No 5

How many years have you been at the lake? 2 or less 2
2 - 5 years 7
5-10 years 5
Over 10 years 14

How do you use the lake (mark all that apply)

<u>24</u> Swimming	<u>1</u> Irrigation
<u>26</u> Boating	<u>1</u> Drinking water
<u>28</u> Fishing	<u>0</u> Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 27 No 1

Do you currently participate in a weed control project on the lake? Yes 16 No 10

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 26 No 1

Does the level of vegetation in the lake affect your property values? Yes 20 No 2

Are you in favor of continuing efforts to control vegetation on the lake? Yes 28 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 22 No 4

Mark any of these you think are problems on your lake:

<u>2</u> Too many boats access the lake
<u>7</u> Use of jet skis on the lake
<u>1</u> Too much fishing
<u>6</u> Fish population problem
<u>7</u> Dredging needed
<u>6</u> Overuse by nonresidents
<u>20</u> Too many aquatic plants
<u>1</u> Not enough aquatic plants
<u>12</u> Poor water quality
<u>0</u> Pier/funneling problem

Please add any comments:

Too many bass clubs; week of October 9 there was a fishy chemical smell; has anyone checked to see if herbicides from surrounding farms have seeped into the lake?; the meeting should be during the summer so that more people can vote.

16.5 Resources for Aquatic Management

In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program (USDA)

Conservation Reserve Program (USDA)

Wetlands Reserve Program (USDA)

Grassland Reserve Program (USDA)

Wildlife Habitat Incentive Program (USDA)

Small Watershed Rehabilitation Program (USDA)

The following programs are offered by the U.S. Fish and Wildlife Service. More information about the Fish and Wildlife service can be found at www.fws.gov

Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service)

Bring Back the Natives Program (U.S. Fish and Wildlife Service)

Native Plant Conservation Program (U.S. Fish and Wildlife Service)

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/

U.S. Environmental Protection Agency Environmental Education Program (EPA)

NPDES Related State Program Grants (IDEM)

Community Forestry Grant Program (U.S. Forest Service)

16.6 State Regulations for Aquatic Plant Management

The following information is found on the IDNR website and outlines general regulations for the management of aquatic plants in public waters.

AQUATIC PLANT CONTROL PERMIT REGULATIONS

Indiana Department of Natural Resources

Note: In addition to a permit from IDNR, public water supplies cannot be treated without prior written approval from the IDEM Drinking Water Section. **Amended state statute adds biological and mechanical control (use of weed harvesters) to the permit requirements, reduces the area allowed for treatment without a permit to 625 sq ft, and updates the reference to IDEM. These changes become effective on July 1, 2002.**

Chapter 9. Regulation of Fishing

IC 14-22-9-10

Sec. 10. (a) This section does not apply to the following:

- (1) A privately owned lake, farm pond, or public or private drainage ditch.
- (2) A landowner or tenant adjacent to public waters or boundary waters of the state, who chemically, mechanically, or physically controls aquatic vegetation in the immediate vicinity of a boat landing or bathing beach on or adjacent to the real property of the landowner or tenant if the following conditions exist:

- (A) The area where vegetation is to be controlled does not exceed:

- (i) twenty-five (25) feet along the legally established, average, or normal shoreline;
- (ii) a water depth of six (6) feet; and
- (iii) a total surface area of six hundred twenty-five (625) square feet.

- (B) Control of vegetation does not occur in a public waterway of the state.

(b) A person may not chemically, mechanically, physically, or biologically control aquatic vegetation in the public waters or boundary waters of the state without a permit issued by the department. All procedures to control aquatic vegetation under this section shall be conducted in accordance with rules adopted by the department under IC 4-22-2.

(c) Upon receipt of an application for a permit to control aquatic vegetation and the payment of a fee of five dollars (\$5), the department may issue a permit to the applicant. However, if the aquatic vegetation proposed to be controlled is present in a public water supply, the department may not, without prior written approval from the department of environmental management, approve a permit for control of the aquatic vegetation.

(d) This section does not do any of the following:

- (1) Act as a bar to a suit or cause of action by a person or governmental agency.
- (2) Relieve the permittee from liability, rules, restrictions, or permits that may be required of the permittee by any other governmental agency.
- (3) Affect water pollution control laws (as defined in IC 13-11-2-261) and the rules adopted under water pollution control laws (as defined in IC 13-11-2-261).

As added by P.L.1-1995, SEC.15. Amended by P.L.1-1996, SEC.64.

312 IAC 9-10-3 Aquatic vegetation control permits

Authority: IC 14-22-2-6; IC 14-22-9-10

Affected: IC 14-22-9-10

Sec. 3. (a) Except as provided under IC 14-22-9-10(a), a person shall obtain a permit under this section before applying a substance to waters of this state to seek aquatic vegetation control.

(b) An application for an aquatic vegetation control permit shall be made on a departmental form and must include the following information:

- (1) The common name of the plants to be controlled.
- (2) The acreage to be treated.

- (3) The maximum depth of the water where plants are to be treated.

- (4) The name and amount of the chemical to be used.

(c) A permit issued under this section is limited to the terms of the application and to conditions imposed on the permit by the department.

(d) Five (5) days before the application of a substance permitted under this section, the permit

holder must post clearly, visible signs at the treatment area indicating the substance that will be applied and what precautions should be taken.

(e) A permit issued under this section is void if the waters to be treated are supplied to the public by a private company or governmental agency. (*Natural Resources Commission*; 312

16.7 Species Distribution Maps

*Rake scores are included at each sample site where a species was collected.

Figure 6: August 2006 Chara Sites



Figure 7: August 2006 Coontail Sites



Figure 8: August 2006 Curly Leaf Pondweed Sites

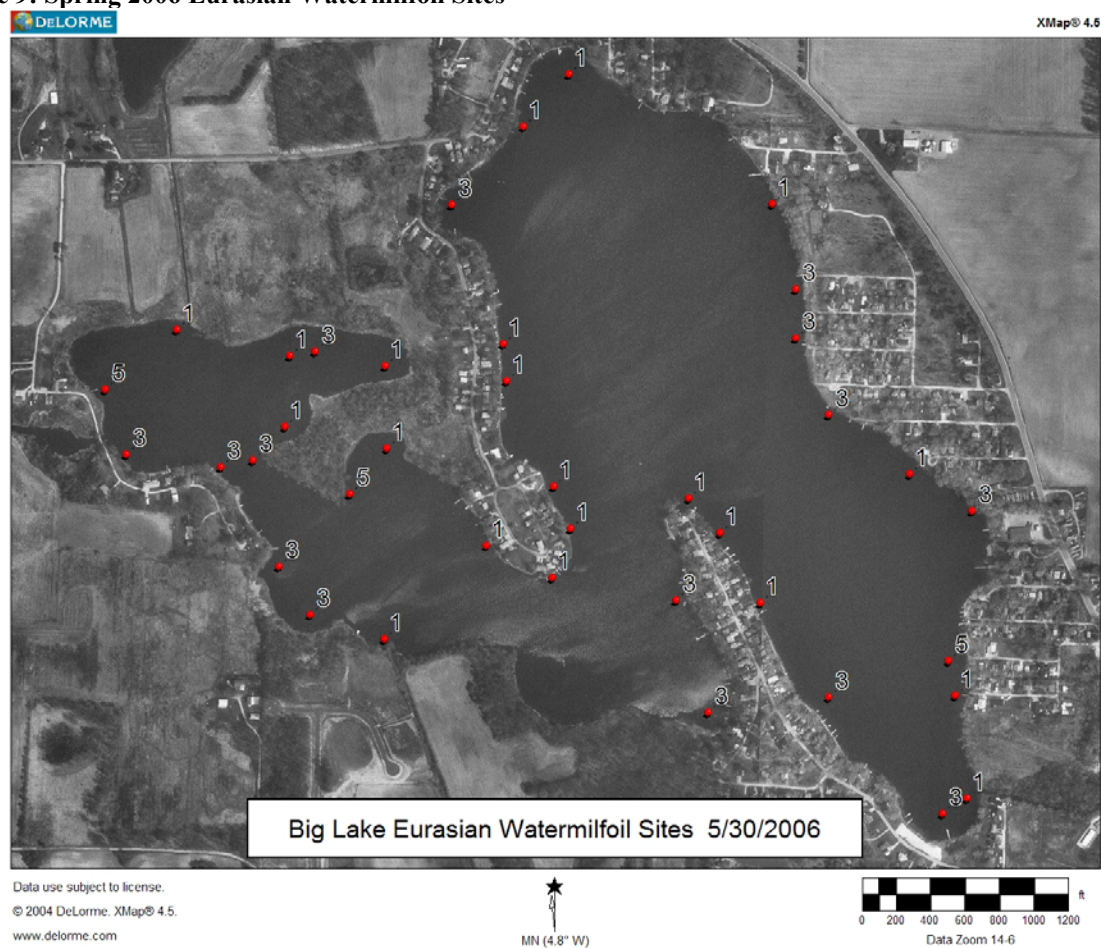
Figure 9: Spring 2006 Eurasian Watermilfoil Sites

Figure 10: August 2006 Eurasian Watermilfoil Sites

Figure 11: August 2006 Eelgrass Sites

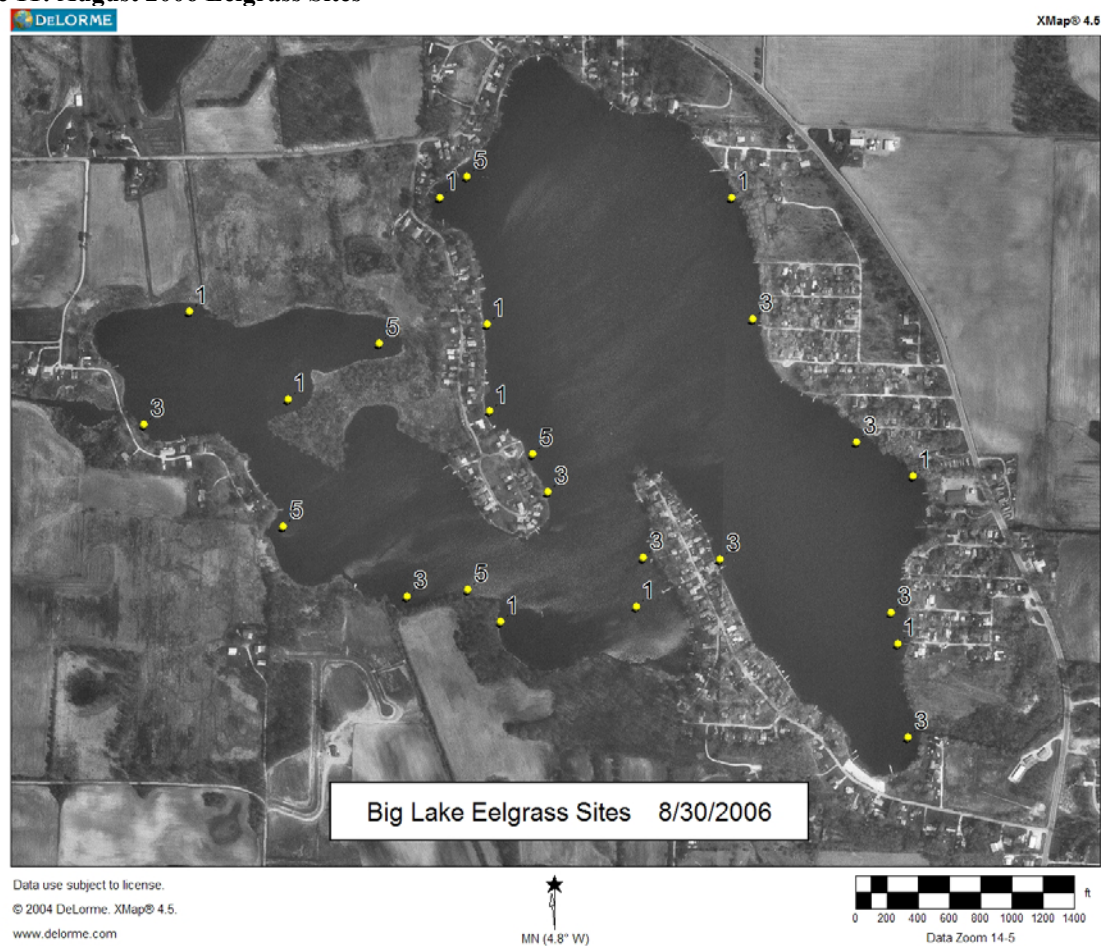


Figure 12: August 2006 Elodea Sites



Figure 13: August 2006 Elodea Sites



Figure 14: August 2006 Largeleaf Pondweed Sites

Figure 15: August 2006 Leafy Pondweed Sites



Figure 16: August 2006 Richardson's Pondweed Sites

Figure 17: August 2006 Sago Pondweed Sites



Figure 18: August 2006 Slender Naiad Sites



16.8 Data Sheets

Submersed Aquatic Plant Survey Form

Page 1 of 2¹¹

WATER BODY NAME		Big Lake		SECCHI	2.5														
COUNTY		Noble		MAX PLANT DEPTH		15 (12)													
DATE		Aug. 30, 2006		WEATHER		cloudy breezy low 70s													
CREW LEADER		Jim Danaher		COMMENTS		Eutrophication													
RECORDER		Dave Kryster				30 0-5 20 5-10 10 10-15													
Rate score (1, 3, 5), observed only (9), algae present (p)																			
Use acronyms for species, V1, V2...for voucher codes																			
Note																			
Species Code																			
Site	Latitude	Longitude	Depth	All	CE	FE	EU	VA	NA	EL	CH	HA	SA	AL	PO	IL	A		
1	GPS	Points	5	3	3														
2	↓	↓	3.5	5			5	1											
3			2.5	5	3	3	1	3	3	1									
4			2	5	3	3	1	1						1					
5			5	3	1	3												P	
6			3	5	5	1	1											P	
7			3	5	5	1	3											P	
8			3.5	5	5	1	3											P	
9			5	3	3														
10			3	3	1	1	3												
11			2	3		1	1												
12			3.5	5		3	1								3	1			
13			3	3	1	3													
14			5	3	3									1		1			
15			3	3	3														
16			4.5	1	1														
17			5	5	5														
18			4	3	3									1					
19			4	5	3	5									1				
20			4.5	5	5	3													
21			3	3	3									1					
22			2	3	1	1								1					
23			2.5	3	3	1												P	
24			2.5	1	1														
25			4	1	1	1													
26			3.5	5	1	5													
27			3	5		1				5						1		P	
28			2.5	5	1		1											P	
29			2	3	1									1				P	
30			4	1	1													P	
31			7.5	0															
32			8.5	0															
Other plant species observed at lake																			

PUCN) P

PUCN) 2-1

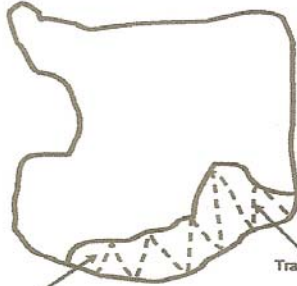
PUCN) 3-1

Submersed Aquatic Plant Survey Form

Page 2 of 2¹¹

WATER BODY NAME <u>Big Lake</u>				SECCHI <u>2.5</u>											
COUNTY <u>Noble</u>				MAX PLANT DEPTH <u>15 (12)</u>											
DATE <u>Aug 30, 2006</u>				WEATHER <u>cloudy, breezy, cool, low 70s</u>											
CREW LEADER <u>Jim Donahoe</u>				COMMENTS											
RECORDER <u>Dave Keister</u>															
				Rake score (1, 3, 5), observed only (9), algae present (p)											
				Use acronyms for species, V1, V2...for voucher codes								Note			
Species Code															
Site	Latitude	Longitude	Depth	All	CENE	UAM	NAFL	ELG	CHAD	LEAF	MYSD	POPG	POZL	A	
GPS Point															
33			8	0											
34			6.5	3	1		1								
35			8.5	3	3										
36			9.5	0											
37			6	5	3	3									
38			6	3		3	1								
39			9	3		3						1			
40			9	3	1	1									
41			8.5	0											
42			6.5	3	3										
43			7	3	3										
44			7	5	5										
45			6	0											
46			7.5	3	3						3				
47			7.5	3	3										
48			10	0											
49			7	5		5									
50			6.5	5		5									
51			12.5	0											
52			13	0											
53			12	1	1							1			
54			13	0											
55			10.5	0											
56			14	0											
57			12	0											
58			12.5	0											
59			15	0											
60			12.5	0											
Other plant species observed at lake															

Large-1

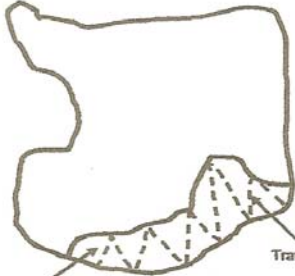
Aquatic Vegetation Plant Bed Data Sheet				Page <u>1</u> of <u>10</u>	
State of Indiana Department of Natural Resources					
ORGANIZATION: <u>Big Lake Assoc.</u>			DATE: <u>8/30/06</u>		
SITE INFORMATION			SITE COORDINATES		
Plant Bed ID: <u>1E</u>			Center of the Bed		
Bed Size: <u>~ large</u>			Latitude: <u>N41 16.178</u>		
Substrate: <u>Z</u>			Longitude: <u>W85 29.618</u>		
Marl? <u>0</u>			Max. Lakeward Extent of Bed		
High Organic? <u>1</u>			Latitude: <u>N41 16.196</u>		
Waterbody Name: <u>Big Lake</u>			Longitude: <u>W85 29.606</u>		
Waterbody ID: <u>6</u>					
Total # of Species <u>6</u>					
Canopy Abundance at Site					
S: <u>—</u> N: <u>1</u> F: <u>3</u> E: <u>1</u>					
SPECIES INFORMATION					
Species Code	Abundance	QE	Vchr.	Ref. ID	
<u>Spatterdock</u>	<u>3</u>				 <p style="margin-top: 10px;">Individual Plant Bed Survey</p> <p style="margin-top: 10px;">Plant Bed ID # 01</p> <p style="margin-top: 10px;">Travel Pattern</p>
<u>Bulrush</u>	<u>1</u>				
<u>Pickernut weed</u>	<u>1</u>				
<u>Arrowhead</u>	<u>1</u>				
<u>cat tail</u>	<u>1</u>				
<u>Duckweed</u>	<u>1</u>				
Comments:					<p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p>
REMINDER INFORMATION					<p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p> <p> </p>
Substrate:	Marl	Canopy:		QE Code:	
1 = Silt/Clay	1 = Present	1 = < 2%		0 = as defined	
2 = Silt w/Sand	0 = absent	2 = 2-20%		1 = Species suspect	
3 = Sand w/Silt		3 = 21-80%		2 = Genus suspected	
4 = Hard Clay	High Organic	4 = > 60%		3 = Unknown	
5 = Gravel/Rock	1 = Present			<p>Reference ID:</p> <p>Unique number or letter to denote specific location of a species; referenced on attached map</p>	
6 = Sand	0 = absent				
Overall Surface Cover		Abundance:			
N = Nonrooted floating		1 = < 2%			
F = Floating, rooted		2 = 2-20%		<p>Voucher:</p> <p>0 = Not Taken</p> <p>1 = Taken, not verified</p> <p>2 = Taken, verified</p>	
E = Emergent		3 = 21-80%			
S = Submersed		4 = > 60%			

Page 2 of 10

Aquatic Vegetation Plant Bed Data Sheet

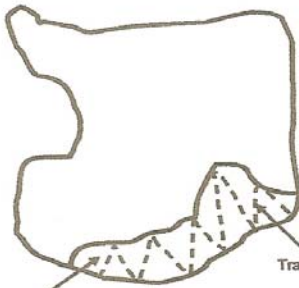
State of Indiana Department of Natural Resources

ORGANIZATION: <u>Big Lake Assoc.</u>		DATE: <u>8/30/06</u>	
SITE INFORMATION		SITE COORDINATES	
Plant Bed ID: <u>2 F</u>	Waterbody Name: <u>Big Lake</u>	Center of the Bed	
Bed Size: <u>50 x 40 ft</u>	Waterbody ID:	Latitude: <u>N 41° 16.448</u>	Point #3
Substrate: <u>2</u>	Total # of Species: <u>1</u>	Longitude: <u>W 85° 29.541</u>	
Marl? <u>0</u>	Canopy Abundance at Site	Max. Lakeward Extent of Bed	
High Organic? <u>0</u>	S: <u>0</u> H: <u>0</u> F: <u>0</u> E: <u>4</u>	Latitude: <u>N 41° 16.447</u>	Point #3
		Longitude: <u>W 85° 29.597</u>	

SPECIES INFORMATION					Individual Plant Bed Survey
Species Code	Abundance	QE	Vchr.	Ref. ID	
<u>C. glauca</u>	<u>4</u>				 <p style="text-align: center;">Plant Bed ID # 01</p>

REMINDER INFORMATION			
Substrate: 1 = Silt/Clay 2 = Silt w/Sand 3 = Sand w/Silt 4 = Hard Clay 5 = Gravel/Rock 6 = Sand	Marl: 1 = Present 0 = absent High Organic: 1 = Present 0 = absent	Canopy: 1 = < 2% 2 = 2-20% 3 = 21-60% 4 = > 60% Abundance: 1 = < 2% 2 = 2-20% 3 = 21-60% 4 = > 60%	QE Code: 0 = as defined 1 = Species suspected 2 = Genus suspected 3 = Unknown Voucher: 0 = Not Taken 1 = Taken, not verified 2 = Taken, verified
Reference ID: Unique number or letter to denote specific location of a species; referenced on attached map			

Comments:

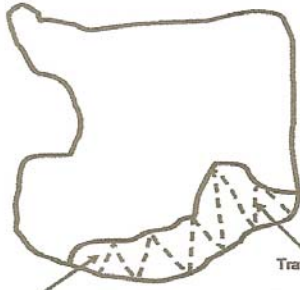
Aquatic Vegetation Plant Bed Data Sheet						Page <u>3</u> of <u>10</u>			
State of Indiana Department of Natural Resources									
ORGANIZATION: Big Lake Assoc.				DATE: 8/30/06					
SITE INFORMATION				SITE COORDINATES					
Plant Bed ID: 3E	Waterbody Name: Big Lake			Center of the Bed					
Bed Size: ~ 15m ²				Latitude: N 41° 16' 65"					
Substrate: 2	Waterbody ID:			Longitude: W 85° 30' 35.4"					
Mari? 0	Total # of Species: 6			Max. Lakeward Extent of Bed					
High Organic? 1	Canopy Abundance at Site			Latitude: N 41° 16' 48.7", W 85° 30' 24.9"					
	S: -	N: 1	F: 3	E: 8	Longitude: N 41° 16' 27.9" - W 85° 29' 44.7"				
SPECIES INFORMATION									
Species Code	Abundance	QE	Ychr.	Ref. ID	Individual Plant Bed Survey  <p>Travel Pattern</p> <p>Plant Bed ID # 01</p>				
Ranunculus	3								
Sagittaria	3								
White Lily	2								
Sweetflag	1								
Purple Loosestrife	1								
Duckweed	1								
REMINDER INFORMATION								Comments: 	
Substrate:	Mari:	Canopy:		QE Code:	Reference ID:				
1 = Silt/Clay	1 = Present	1 = < 2%		0 = as defined	Unique number or letter to denote specific location of a species; referenced on attached map				
2 = Silt w/Sand	0 = absent	2 = 2-20%		1 = Species suspect					
3 = Sand w/Silt		3 = 21-60%		2 = Genus suspected					
4 = Hard Clay	High Organic:	4 = > 60%		3 = Unknown					
5 = Gravel/Rock	1 = Present								
6 = Sand	0 = absent								
Overall Surface Cover		Abundance:		Voucher:					
N = Nonrooted floating		1 = < 2%		0 = Not Taken					
F = Floating, rooted		2 = 2-20%		1 = Taken, not verified					
E = Emergent		3 = 21-60%		2 = Taken, verified					
S = Submersed		4 = > 60%							

Page 4 of 10

Aquatic Vegetation Plant Bed Data Sheet

State of Indiana Department of Natural Resources

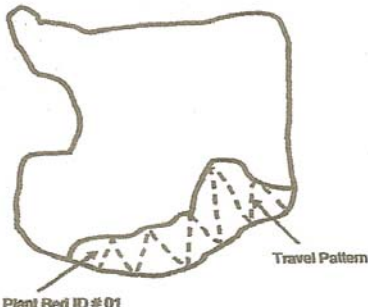
ORGANIZATION: <u>Big Lake Assoc.</u>		DATE: <u>8/30/06</u>	
SITE INFORMATION		SITE COORDINATES	
Plant Bed ID: <u>4E</u>	Waterbody Name: <u>Big Lake</u>	Center of the Bed	
Bed Size: <u>Very small</u>	Waterbody ID: <u> </u>	Latitude: <u>N 41 16.262</u>	Point #6
Substrate: <u>2</u>	Total # of Species: <u>1</u>	Longitude: <u>W 85 30.069</u>	
Marl? <u>0</u>	Canopy Abundance at Site	Max. Lakeward Extent of Bed	
High Organic? <u>1</u>	S: <u>-</u> H: <u>0</u> F: <u>4</u> E: <u>0</u>	Latitude: <u>N 41 16.367</u>	
		Longitude: <u>W 85 30.070</u>	

SPECIES INFORMATION					Individual Plant Bed Survey
Species Code	Abundance	QE	Vchr.	Ref. ID	
<u>White Lilly</u>	<u>4</u>				 <p style="text-align: right;">Travel Pattern</p> <p>Plant Bed ID # 01</p>

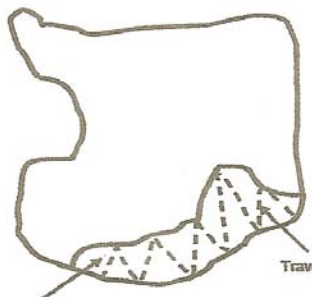
REMINDER INFORMATION				
Substrate:	Marl	Canopy:	QE Code:	Reference ID:
1 = Silt/Clay	1 = Present	1 = < 2%	0 = as defined	Unique number or letter to denote specific location of a species; referenced on attached map
2 = Silt w/Sand	0 = absent	2 = 2-20%	1 = Species suspected	
3 = Sand w/Silt		3 = 21-60%	2 = Genus suspected	
4 = Hard Clay	High Organic	4 = > 60%	3 = Unknown	
5 = Gravel/Rock	1 = Present			
6 = Sand	0 = absent			
	Overall Surface Cover	Abundance:	Voucher:	
	N = Nonrooted floating	1 = < 2%	0 = Not Taken	
	F = Floating, rooted	2 = 2-20%	1 = Taken, not verified	
	E = Emergent	3 = 21-60%	2 = Taken, verified	
	S = Submersed	4 = > 60%		

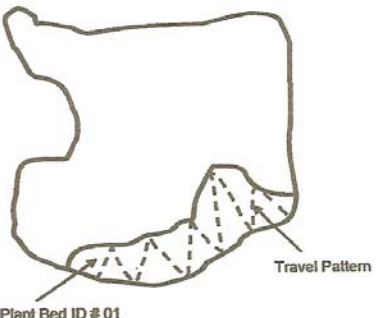
[illegible]

[illegible]

Aquatic Vegetation Plant Bed Data Sheet						Page <u>7</u> of <u>10</u>
State of Indiana Department of Natural Resources						
ORGANIZATION: <u>Big Lake</u>			DATE: <u>8/30/06</u>			
SITE INFORMATION			SITE COORDINATES			
Plant Bed ID: <u>35</u>	Waterbody Name: <u>Big Lake</u>		Center of the Bed			
Bed Size: <u>2.5 acres</u>	Waterbody ID: <u>2</u>		Latitude: <u>N 41 16.546</u>			
Substrate: <u>2</u>	Total # of Species: <u>2</u>		Longitude: <u>W 85 30.376</u>			
Mad? <u>0</u>	High Organic? <u>1</u>		Max. Lakeward Extent of Bed			
Canopy Abundance at Site			Latitude: <u>N 41 16.492</u>			
S: <u>4</u> H: <u>-</u> F: <u>-</u> E: <u>-</u>			Longitude: <u>W 85 30.401</u>			
SPECIES INFORMATION						
Species Code	Abundance	QE	Vchr.	Ref. ID	Individual Plant Bed Survey	
CEDEU	3					
MYS P2	2					
Comments:						
REMINER INFORMATION						
Substrate:	Mud	Canopy:	QE Codes:	Reference ID:		
1 = Silt/Clay	1 = Present	1 = < 2%	0 = as defined	Unique number or		
2 = Silt w/ Sand	0 = absent	2 = 2-20%	1 = Species suspected	letter to denote specific		
3 = Sand w/ Silt		3 = 21-60%	2 = Genus suspected	location of a species;		
4 = Hard Clay	High Organic	4 = > 60%	3 = Unknown	referenced on attached map		
5 = Gravel/Rock	1 = Present					
6 = Sand	0 = absent					
Overall Surface Cover		Abundance:	Voucher:			
N = Nonrooted floating		1 = < 2%	0 = Not Taken			
F = Floating, rooted		2 = 2-20%	1 = Taken, not verified			
E = Emergent		3 = 21-60%	2 = Taken, verified			
S = Submersed		4 = > 60%				

[illegible]

Aquatic Vegetation Plant Bed Data Sheet						Page <u>9</u> of <u>10</u>	
State of Indiana Department of Natural Resources							
ORGANIZATION: <u>Big Lake Assoc</u>				DATE: <u>8/30/06</u>			
SITE INFORMATION				SITE COORDINATES			
Plant Bed ID: <u>55</u>	Waterbody Name: <u>Big Lake</u>			Center of the Bed			
Bed Size: <u>1/4 ac</u>	Waterbody ID:			Latitude: <u>N 41 16.362</u>	Longitude: <u>W 85 30.069</u>		
Substrate: <u>2</u>	Total # of Species: <u>1</u>			Max. Lakeward Extent of Bed			
Marl? <u>0</u>	High Organic? <u>1</u>			Latitude: <u>N 41 16.367</u>	Longitude: <u>W 85 30.070</u>		
Canopy Abundance at Site							
S: <u>9</u>	N: <u>-</u>	F: <u>-</u>	E: <u>-</u>				
SPECIES INFORMATION							
Species Code	Abundance	QE	Vchr.	Ref. ID	Individual Plant Bed Survey 		
CEDE 4	4						
					Comments:		
REMINDER INFORMATION					Reference ID: Unique number or letter to denote specific location of a species; referenced on attached map		
Substrate:	Marl	Canopy:		QE Code:			
1 = Silt/Clay	1 = Present	1 = < 2%		0 = as defined			
2 = Silt w/Sand	0 = absent	2 = 2-20%		1 = Species suspect			
3 = Sand w/Silt		3 = 21-60%		2 = Genus suspected			
4 = Hard Clay	High Organic	4 = > 60%		3 = Unknown			
5 = Gravel/Rock	1 = Present			Voucher: 0 = Not Taken 1 = Taken, not verified 2 = Taken, verified			
6 = Sand	0 = absent						
Overall Surface Cover		Abundance:					
N = Nonrooted floating		1 = < 2%					
F = Floating, rooted		2 = 2-20%					
E = Emergent		3 = 21-60%					
S = Submersed		4 = > 60%					

Aquatic Vegetation Plant Bed Data Sheet						Page 10 of 10
State of Indiana Department of Natural Resources						
ORGANIZATION: <u>Big Lake Assoc.</u>				DATE: <u>8/30/06</u>		
SITE INFORMATION				SITE COORDINATES		
Plant Bed ID: <u>65</u>	Waterbody Name: <u>Big Lake</u>			Center of the Bed		
Bed Size: <u>10 acres</u>	Waterbody ID:			Latitude: <u>N 41 16.290</u>		
Substrate: <u>2</u>	Total # of Species: <u>5</u>			Longitude: <u>W 85 29.943</u>		
Marl? <u>0</u>	High Organic? <u>1</u>			Max. Lakeward Extent of Bed		
Canopy Abundance at Site				Latitude: <u>N 41 16.523</u>		
S: <u>4</u> N: <u>-</u> E: <u>-</u>				Longitude: <u>W 85 30.019</u>		
SPECIES INFORMATION						
Species Code	Abundance	QE	Vchr.	Ref. ID	<div style="text-align: center;"> <p>Individual Plant Bed Survey</p>  </div>	
<u>CEDEU</u>	<u>3</u>					
<u>KYSP2</u>	<u>1</u>					
<u>UAAM3</u>	<u>3</u>					
<u>LAR6E</u>	<u>1</u>					
<u>POPE6</u>	<u>1</u>					
Comments:						
REMINDER INFORMATION						
Substrate:	Marl	Canopy:		QE Code:	Reference ID:	
1 = Silt/Clay	1 = Present	1 = < 2%		0 = as defined	Unique number or	
2 = Silt w/Sand	0 = absent	2 = 2-20%		1 = Species suspa	letter to denote specific	
3 = Sand w/Silt		3 = 21-60%		2 = Genus suspected	location of a species;	
4 = Hard Clay	High Organic	4 = > 60%		3 = Unknown	referenced on attached map	
5 = Gravel/Rock	1 = Present					
6 = Sand	0 = absent					
Overall Surface Cover		Abundance:		Voucher:		
N = Nonrooted floating		1 = < 2%		0 = Not Taken		
F = Floating, rooted		2 = 2-20%		1 = Taken, not varified		
E = Emergent		3 = 21-60%		2 = Taken, varifier		
S = Submersed		4 = > 60%				

16.9 Permit Application



APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R / 11-03)

Approved State Board of Accounts 1987

☐ Whole Lake

☒ Multiple Treatment Areas

☒ Multiple
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY

License No.

Date Issued

Lake County

Return to: Page 1 of _____
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE:	\$5.00
------	--------

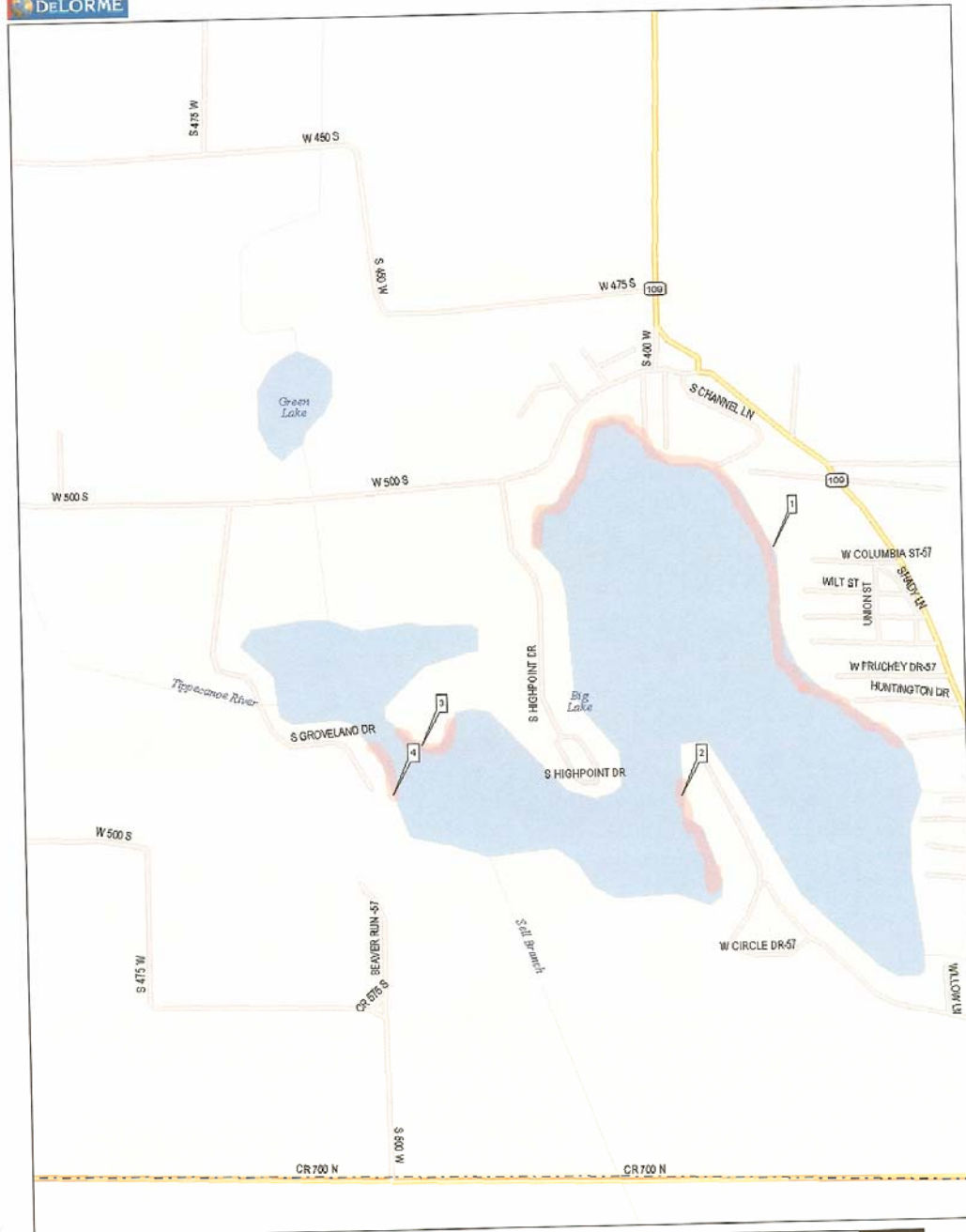
[illegible]

Treatment Area #	2	LAT/LONG or UTM's N41degrees 16.392 W85 30.006	
Total acres to be controlled	10	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft) 100
Minimum Depth of Treatment (ft)	5	Expected date(s) of treatment(s) June	
Treatment method: <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Physical <input type="checkbox"/> Biological Control <input type="checkbox"/> Mechanical			
Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Renovate			
Plant survey method: <input checked="" type="checkbox"/> Rake <input type="checkbox"/> Visual <input type="checkbox"/> Other (specify)			
Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community	
Eurasian Milfoil	X	80	
Coontail		10	
Algae		10	
Areas will be better defined after spring survey			
<i>INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.</i>			
Applicant Signature		Date	
Certified Applicant's Signature		Date	
FOR OFFICE ONLY			
<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	Fisheries Staff Specialist		
<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	Environmental Staff Specialist		
Mail check or money order in the amount of \$5.00 to: DEPARTMENT OF NATURAL RESOURCES DIVISION OF FISH AND WILDLIFE COMMERCIAL LICENSE CLERK 402 WEST WASHINGTON STREET ROOM W273 INDIANAPOLIS, IN 46204			

Aquatic Weed Control

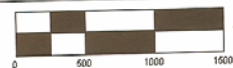
DeLORME

Street Atlas USA® 2004 Plus



© 2003 DeLorme
www.delorme.com

MN (4.9° W)



Data Zoom 14-1